THE ELECTRICAL WORLD

A Weekly Review of Current Progress in Electricity and its Practical Applications

VOL. I.—No. 21. NEW YORK, MAY 26, 1883. $2 A YEAR. 5 CENTS PER COPY.

The Portland Telephone Exchange.

We have already referred in THE ELECTRICAL WORLD to some novel and valuable features in the system of the Portland (Me.) telephone exchange. We publish this week an illustration showing the new switches, which we think will prove interesting to our telephone readers. Superintendent Farnham has kindly furnished us with the following additional details :

The switch-boards differ from others in several respects, and we adopted this form after carefully looking over the ground. We corresponded with several electricians, and visited the Boston, Providence, Lowell, and other noted exchanges. Of all the switches in use, the Williams switch seemed the most suitable, as the nearest approach to a perfect switch. It seemed possible to us, however, to improve it in several details, and we made attempts in that direction, with the success of which we are very much pleased, after an experience of several weeks in the busy season.

In the Williams switch, as is well known, the connections are made in such a manner that when subscribers on two distinct sections are connected, both using strips above the annunciator, there is no annunciator included in the circuit.

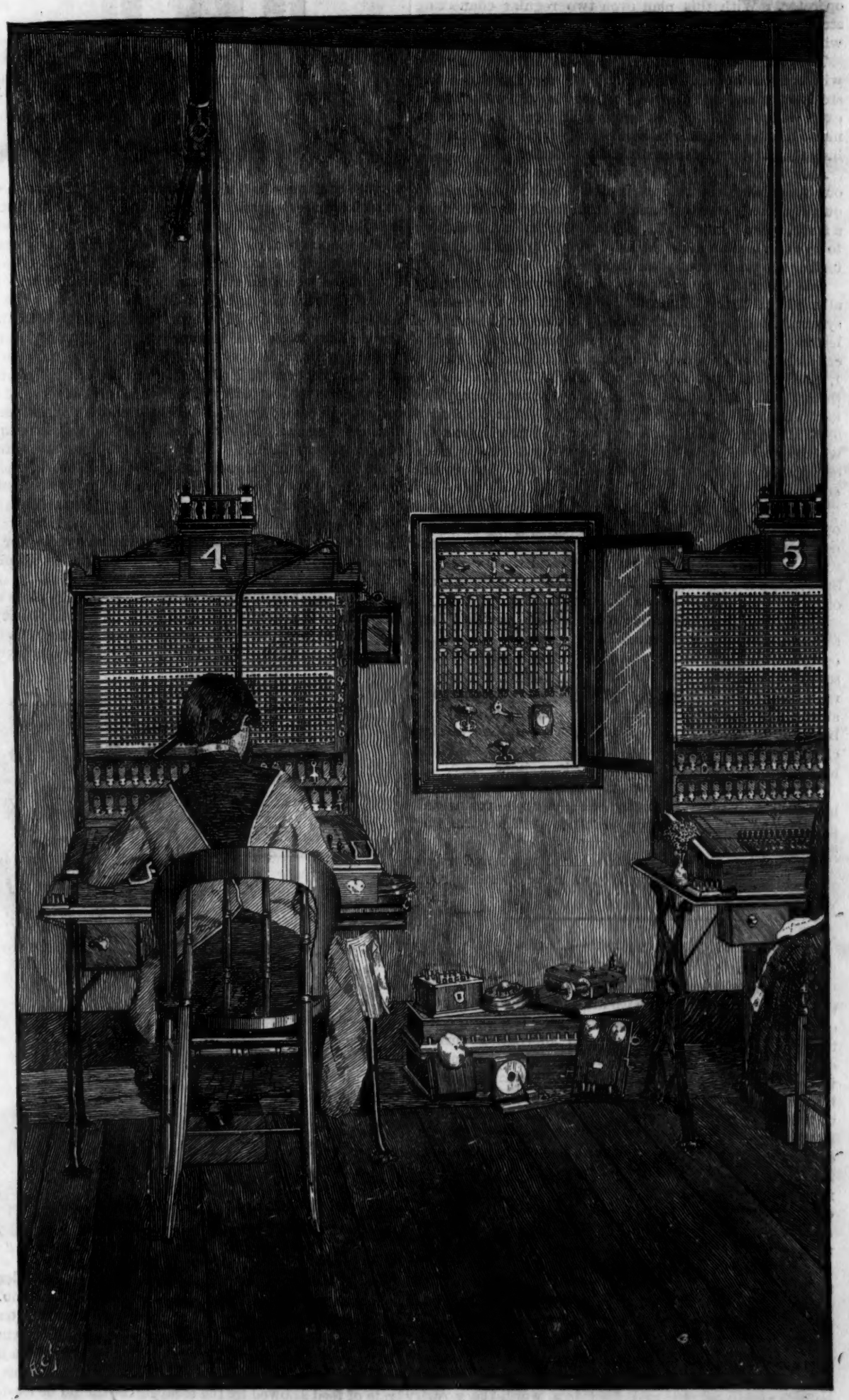
We have had our switch so constructed that an annunciator is *always* included in the talking circuit and ready to take the call. No connection can be made without giving subscribers a chance to call the central office if they wish.

In operating with the Williams switch, whenever subscribers on two different sections are connected, it is the duty of both operators to see to it that the sections are not disconnected too soon. In many cases, however, one of these operators may be "rushed," while the other has but few connections to handle ; consequently one may disconnect the subscriber on his line before the other discovers that the conversation is closed. If one operator disconnects before the other, the line remaining on the connecting strip is "open," and the subscribers on that line cannot call the central office. In order to avoid this trouble in our switch we have added on the left hand end of each connecting bar or strip a little key or spring, which stands just clear of the connecting strips. The several keys are all connected with the battery used to call subscribers. When a subscriber on section 2 is connected with a subscriber on section 5, and the operator on 2 finds they are done speaking, he immediately disconnects his line from the strips and presses the key corresponding to the particular strip on which the connection had been made. This throws a battery current to the corresponding strip on section 5, thence over the subscriber's line which is still connected on that section. This drops the annunciator on that line and calls the operator's attention. The single click of the annunciator which is produced by this operation differs so much from a regular call by a subscriber that the operator readily recognizes it as a signal to disconnect. In this way the operator who first discovers that the conversation is ended signals the other, and both lines are disconnected at once. In our opinion this is a safer plan than having subscribers signal to disconnect, especially in systems like ours where each line goes to more than one subscriber.

Another method of avoiding the trouble named is to have a ground switch at each slip. This obliges the operator to make an extra movement for every connection, several in fact, when the movements of both operators are considered, as the ground on both sections must be cut off when a connection is made and replaced when the subscribers are disconnected.

Another improvement is as follows: The Williams switch has heretofore been constructed with four connecting bars from a given section to every other section. In an office containing 12 sections of switch there must be at least 48 connecting bars, including 4 for local work. This gives four and only four chances at a time for making connections between any two sections.

It is evident that the larger the exchange the more frequently will the necessity arise for a greater number of connections at a time. It is also clear that increas-



PORTLAND TELEPHONE EXCHANGE.

SHOWING ONE OF THE TWELVE SECTIONS.

ing the number of connecting strips would soon make the switch too large to be easily reached by the operators.

In our switch four strips are taken for local connections, where both subscribers are on the same section, and *three* to every other table. Then we have a set of three connected to each section, so that on these three strips any section in the exchange can be reached. This gives us six chances from one section to every other, three regular strips connecting only with a given section, and these three others which connect with all sections. It also makes a much less bulky switch, while a still greater number of sections can be used in the exchange.

If operator 2 has his three strips in use with section 5, he immediately takes one of the extra set. To prevent some other section using the same extra strip at the same time (which would mix the parties) there is a set of hands or indicators on each switch corresponding to the extra strip. When an operator uses one of these strips the indicator hand corresponding to that strip on each section turns, informing all operators that the strip is in use. The indicator hand is turned by a circuit that is closed, either automatically when the subscriber's plug is inserted in the extra strip, or by a simple press and pull switch, moved by the operator. With this plan even two regular connecting strips between individual sections and these extra strips will work nicely. At least we find it so here.

The plan of using a certain number of strips connecting with sections in combination with the regular connecting strips or points, and the plan of showing the use of these extra strips by indicators or annunciators, either automatic or otherwise, have been carefully described and illustrated, and application made for patents.

Another addition to this system, not used elsewhere to our knowledge, is a supplementary switch designed to quickly change any transmitter from its regular battery to a fresh, spare battery; also to change from a call battery to a spare; also an arrangement for rapidly and accurately testing the strength of these batteries.

One other improvement to which you have already alluded in THE ELECTRICAL WORLD, is the number system. Each section is known by a number instead of a letter. The first section is 0 (cipher) and takes subscribers below one hundred. The second section is marked 1, and takes subscribers from 101 to 199, and so on throughout. Any subscriber is on the section corresponding to his hundred number. Subscriber 581 is on section 5. This greatly assists the operator in knowing exactly where every subscriber is located. We put two or more on a line, the odd and even numbers showing how to call either one.

Each operator communicates by telephone with other operators. No loud talk, no walking, no messengers are necessary. Each section could be placed in a separate room, and the work still go on quietly and with dispatch. Subscribers are classified so that those who communicate often with each other are on the same section.

The average time of making a connection now is thirty seconds, while many are made in ten seconds. The chief operator has a desk in the centre of the room where he can see all that is going on, and not only has telephonic arrangements whereby he may quickly speak with any operator, the superintendent or be connected with any subscriber; but he also has a loop from each operator's talking circuit, so that he can at once loop into any section and hear what the operator or subscriber is saying.

The line wires come down to each section through a bronzed steam pipe, perfectly straight and ornamental, giving none of the slovenly appearance of loose wires or zig-zag cables.

A dressing room, battery room, stock room and repair shop are connected with the light and airy operating room which is 30 by 40 feet.

Electric Lighting.—XXVII.

It is an interesting peculiarity of the Alteneck regulator that it will work as well with alternate currents as with continuous currents. As a matter of fact, it was for a long time used by Messrs. Siemens with alternating currents only, in installations, and it is still worked in this manner to some extent in Germany. This result is made possible by the use of solenoids; evidently it could not be obtained with electro-magnets. In an electro-magnet the core itself must become sensibly magnetic before it begins to exert any attractive influence on its armature. Its magnetism does not rise suddenly, but more or less gradually, as fast as it overcomes the coercive force of the iron. If the current is reversed just as the magnetism is about to attract its armature, the magnetism will decrease and will then pass through a phase of increase of the opposite polarity. If the current alternates very rapidly, then the magnetism does not rise to an appreciable extent, for the simple reason that it is reversed in polarity before it has time to do so. But the polarity of the core moving within a solenoid must be also subject to rapidly alternating changes of polarity under the influence of alternating currents. Nevertheless, the action of the current inside the helix is more energetic and rapid; in a word, the polarity due to each impulse becomes established so quickly, at least on the surface of the core, that it has time to feel an attractive force before it is reversed. Thus each impulse contributes a little to the attraction, and the core moves in the solenoid, even though its own magnetic power would be so confined that it would not influence a piece of iron placed near it.

A point of great merit in the Alteneck lamp is the manner in which the clockwork is adapted to the moving core, so as to be moved up and down with varying changes. This makes it answer the purpose of a clutch. In clutch lamps the arrangement of parts is such that, when the main current magnet pulls strongly, there is a device attached in some way to the armature, which binds against the carbon rod either by friction or otherwise. This device is moved by the armature, and as the main

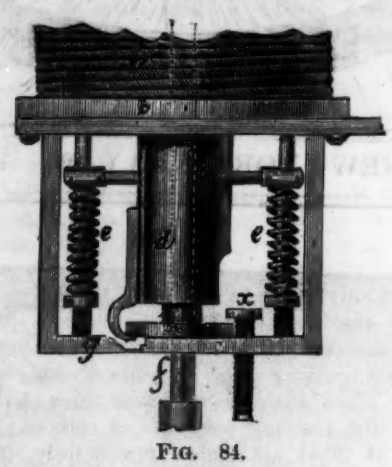


FIG. 84.

magnet continues to pull, the carbon rod is moved upward to cause separation. The action of the shunt circuit in this case tends to effect the release of the clutch, and to allow the carbon rod to slip down sufficiently to compensate for the carbon burned. There is a point of equilibrium between the main and shunt circuit, where the carbon rod slips through just enough to maintain the arc steady. Practically, however, difficulties constantly arise. The carbon rod becomes rusty, worn or bent at certain points, and the result is it will slip more easily at certain portions of its length than at others. Hence, in one case the carbon will slip entirely down, and the carbon will come in contact. Of course they will separate instantly again. Nevertheless this slip has caused a temporary flicker. Now in the Atteneck lamp, when the main magnet pulls, the clockwork moves upward; its escapement is bound, and the carbon is literally clutched and moves up also. Then the escapement is released as occasion requires, and the carbon moves down a slight distance, but it can never slip, for the reason that it cannot move faster than the escapement will permit. If, however, the carbon burned faster than the escapement permitted it to move down, then the whole mechanism is moved down, and thus the carbon fed at the proper additional rate. This means of regulating the feed is much more reliable than the use of "dash-pots," which

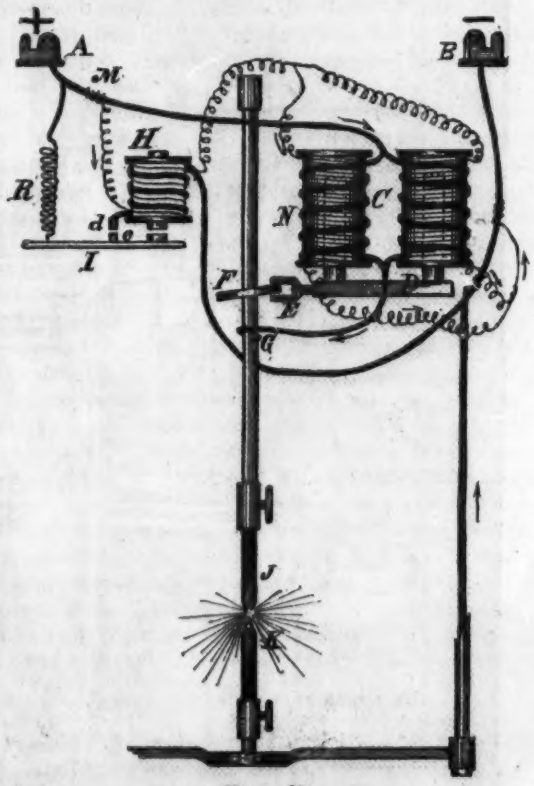


FIG. 85.

is resorted to in clutch lamps, because it is independent of atmospheric changes and other causes of variation. If there can be any improvement suggested in the Alteneck lamp, it is, perhaps, in providing a gradual escapement; that is to say, in arranging the escapement in such a manner that when the mechanism is moved up to its limit, the rate of feed allowed by the escapement should be least, but should increase gradually as the mechanism moves down. With this arrangment the regulating solenoids will soon find the point of equilibrium, when the mechanism is held up at a distance which is exactly that where the escapement feeds the carbon at the proper rate. Now, if the carbon is softer or harder at a given position, then only a little motion will fix the rate of feed. As the lamp is made at present, the rate of escapement of the carbon has to be adjusted so as to be faster than the rate of consumption. Were it not for that, a soft portion of the carbons calling for increased feed would cause the mechanism to move down as far as it could, to make the carbon feed faster than the escapement would permit, as already explained; but as this motion is limited, when it came to a stop the rate of feed would then be dependent entirely on the escapement, and the arc would inevitably lengthen. By making the rate of feed greater than actually necessary this is obviated, but the feed is more or less intermittent. In watching the action of such a lamp it will be found that a few teeth escape only at small intervals. Of course, the mechanism moves down and feeds the carbon that way, and comes up slightly each time the escapement operates, but this would be almost entirely obviated with a graduated escapement, and the occasions for any movement of the regulating mechanism would be very rare.

BRUSH.

This differential lamp is, perhaps, better known, we might even say more celebrated, than any other, on account of the extensive use to which it has been put in this country and abroad. It is, indeed, an excellent lamp, the prototype of the modern clutch lamp. Clutch lamps had been made long before, and many have been made since, but none are simpler or more efficient.

As previously stated, Mr. Brush is a pioneer in the use of the differential principle. It is not known definitely when he conceived its application to his arc lamp, but it does not appear to have been previous to 1877, as he took out his first patents in that year on an arc lamp embodying the clutch and other features still used in the Brush lamp of to-day, though showing no indication or suggestion of

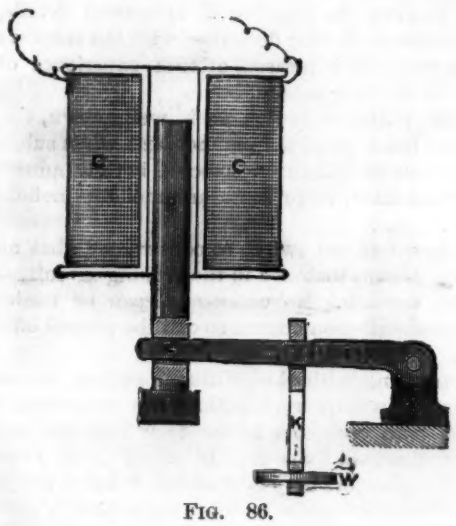


FIG. 86.

the differential principle. It is but fair to presume that if he had been aware of the advantage of this expedient, he would have been as careful to cover it as he has been to cover everything else relating to his lamp. It does not seem probable, therefore, that he has preceded either of the European claimants to the discovery. It matters but little, however, whether he was the first to apply the principle. He was undoubtedly the first in this country, and his patents, obtained from 1878 to 1880, place him on record as such. Mr. Brush deserves a much greater share of credit than his European rivals. He has brought to light an application of the derived circuit of arc lamps, which is of as much convenience and importance as the principle of automatic regulation. It is the device called the "automatic cut-out," by means of which a lamp cuts itself out of the circuit, providing a by-path for the current when out of order, or when from any cause its operation would be attended with danger to the lamp itself. This is most useful when the lamps are burned in long circuits, in which case the liability to mishaps is greater. In the majority of cases, the trouble comes from the failure of the lamps to feed, and from the abnormal lengthening of the arc. The cut-out is intended to operate precisely under this condition.

The inventive genius of Mr. Brush has also shown itself in the construction of a lamp provided with two or three sets of carbons, arranged in such a manner with regard to the regulating mechanism that when one set of carbons is burned the next set is brought into play automatically. There are now several double lamps in the market, but it seems that Mr. Brush was the first to accomplish this feat, and his method of doing it is the simplest of all. As already stated, the Brush lamp is constructed on the clutch principle. The mechanism is remarkably simple and ingenious, and what is equally desirable, it is compact. Fig. 84 shows the clutch mechanism of the Brush lamp. A hollow iron tube *d* moves up and down into a hollow coil or solenoid *a*, shown only in part in the figure. The letter *b* shows the end of the spool on which this solenoid is wound. This solenoid tends by its action to suck the hollow core *d* upward This core may be considered the moving armature of the solenoid. It is kept from turning by means of two vertical

pins, which pass through holes in two arms projecting from the core. On these pins are helical springs, the tension of which may be adjusted by thumb-nuts, so that the core may be allowed to fall to a convenient distance only. The core *d* also carries a finger or hook extending downward from its lower end, as shown in the figure. This finger passes underneath the edge of a round washer *h*, which is the clutch itself. This washer or ring has a hole a little larger than the size of the carbon rod. When the lamp is idle the carbon rod *f* is free to slide through both the core *d* and the clutch ring *h*. When the solenoid *a* lifts the core *d*, the finger which extends below the clutch ring *h* lifts up that side of the ring so as to cause it to tilt to one side, and as it tilts it begins to bind against the carbon rod in the same manner that a tent rope tightener grasps its cord. After this the further upward motion of the core *d* lifts the carbon rod with it. This causes the separation between the carbons which is necessary to form the arc, the extent of the motion being limited and governed by an adjustable screw *x*, which is placed on the other side of the ring, and whose head engages the clutch ring in its ascent and stops its upward motion. The solenoid is composed of two distinct circuits, one of a few turns of large wire, connected in the main circuit, the other of many convolutions of fine wire connected in the derived circuit. The derived circuit is connected in such a manner that the magnetic effect it produces tends to neutralize the polarity induced in the core *d* by the main circuit convolutions. Thus, as the length of the arc increases, it is evident that the greater diversion of the current into the derived circuit must tend to demagnetize the core and allow it to fall down. When it has fallen down a certain distance, the ring rests by one edge on the frame-work of the lamp, and it soon releases the carbon rod and permits it to slip through a brief distance, when instantly the core *d* is attracted upward again as before. To prevent the carbon rod from moving down too rapidly it is made hollow, filled with glycerine or some other viscous fluid, and a piston rod attached to the top of the rod cylinder or "horn" slides inside of the carbon rod. By making holes of larger or smaller size through the piston head it can be made

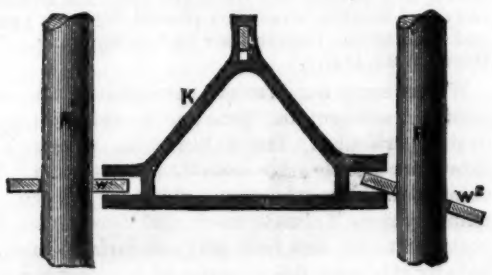


FIG. 87.

to slide in the fluid with varying rapidity. This device has since found its way into almost all the later lamps, in the form of a short cylinder containing a piston which is attached to the armature controlling the motions of the carbons and serves the same purpose as in this case—namely, it "dampens" the motion. The device is familiarly known to electricians as a "dash-pot." The piston-head is usually made of two discs with holes through them, and by turning one of the discs the amount of free opening left in the piston is regulated. When the holes are closed entirely, the motion is very slow, for the fluid in the dash-pot has to pass from one side of the piston to the other by going around the edge of the piston, whereas with the holes left partly open the fluid may pass through more easily, and the motion of the piston is freer.

The accompanying diagram (Fig. 85) shows at a glance all the peculiarities of the Brush lamp, and will perhaps give a clearer idea of its operation. It also shows the cut-out device already referred to. The main circuit, shown by the full dark line, starts from *A*, the positive pole, and divides to pass through the solenoids *C*, two being shown. The current then goes to the body of the lamp, the positive carbon *J*, to the negative carbon *K*, and thence to the negative pole of the lamp *B*, its course being indicated by the arrows. From the positive pole *A* a branch also passes through the resistance *R* to the lever *I*, carrying an armature at its extremity, which is under the influence of the electro-magnet *H*. This lever carries a contact piece *e* that comes in contact with another piece *d*, when the armature is attracted sufficiently. The contact piece *d* is connected with the large wire of the electro-magnet *H*. The other end of this coarse wire goes by a direct connection to the negative pole *B* of the lamp. Thus, by closing the contact *d e* a by-circuit is established, so that the lamp is cut out of the main circuit.

When once the lamp is cut out, the current passing in the large coil of *H* pulls the armature of the lever *I* firmly and insures the permanency of the change, for it will not allow the lever *I* to fall until the current in the main circuit is broken elsewhere. But before this cut-out can act the lever must be attracted to cause the contact at *d e*. This is done by passing the derived current through some fine wire laid on the electro-magnet *H*. The wire is wound in such a manner that both circuits tend to produce the same polarity. The fine lines show this wire. It will be seen that this fine wire is in the same circuit as the fine wire of the regulating solenoids *C*. The course of the current may be traced by the arrows. At the solenoids the current divides, just like the main current, but it runs around in an opposite direction. Supposing the lamp to be idle, on passing the current the armature *D* is pulled upward the fingers *E* tilt the ring *F* and cause it to grasp the carbon. As the arc lengthens the power of the solenoids is weakened by the derived current passing in greater quantity and neutralizing their magnetic action. If, however, the rod happens to be rusty or bent, of if from any other cause the downward movement of the carbon rod is impeded, the current continues to increase in the derived circuit. The electro-magnet *H* pulls more strongly on the lever *I*, and by proper adjustment it may be made to pull it into contact at the proper moment, or whenever the length of the arc would be so great as to cause alarm.

The double lamp does not contain any additional parts besides an additional carbon rod, for the same regulating apparatus controls both sets of carbons. The arrangement by which this is accomplished is extremely simple. The magnet is double, as in the diagram (Fig. 85). The armature *D* causes a lever *L* (Fig. 86) to move up and down. To this lever is attached a triangular frame *K*, shown in profile in Fig. 86, but shown in front view in Fig. 87. In this figure R^1 R^2 are carbon rods slipping through the clutch-rings W^1 W^2. The jaws which hold the clutch-ring are just a trifle higher on one side (W^2) of the frame than the other. When the lamp is idle the two rods R^1 R^2 slide down until the positive carbons come in contact with the negative carbons. When the current is sent through the lamp it passes at first through both sets of carbons, but as the armature is lifted up almost immediately, the clutch, which is situated higher, begins to act and lifts its carbon out of contact, and then the current is passing through one set only. As the armature moves up still further, the second carbon rod is lifted, and an arc established between this carbon and its corresponding negative carbon. Now, when the time comes to feed, this carbon is the first to move down, for its clutch is lower and becomes released first. Therefore, this carbon will continue to feed while the other carbon will remain clutched, and lifted up always too far to come in contact with its corresponding negative carbon. There is a cap at the top of the first carbon rod, and when the carbon has burned sufficiently so the cap comes in contact against a stop and refuses to descend further, then the derived circuit causes the armature to move down further, and now the second carbon is released. It falls down and the first arc goes out, because this set of carbons affords a less resisting path for the current. As soon as the current all passes through the second set of carbons, the armature is pulled up again and the arc re-established. Practically, the change from one set to the other takes place instantaneously.

It will be seen without further explanation how, by using two triangular frames, and making the notches each a little higher than the first two, four sets of carbons might be used. This would be convenient where it is necessary to run for a whole day at a time without interruption. Usually, however, the double lamp is all that is required.

The Brush lamp, as a whole, is a comparatively perfect one. It is skillfully and carefully constructed, and that is one of the reasons for its continued success in the field which it was one of the first to occupy. The use of the piston and glycerine in the tube is, perhaps, open to criticism; not that it is actually objectionable, but because it seems as if something better could be found. The clutch of the Brush lamp is a marvel of simplicity, and it works very nicely, though the rod requires constant attention. It should be thoroughly cleaned every day, to prevent the formation of rusty and rough spots, for these hinder the rod from sliding through the clutch as nicely as it should, and make the lamp flicker. But this is an objection to which all clutch lamps are open. I do not wish to make a plea in favor of clockwork feeds, however, for they have their disadvantages also, and they give their share of trouble as the pivots become rusty, or as the teeth of the wheels wear out, which happens much sooner than is agreeable in many cases. The simple fact is that, even in the face of the thousand and one varied forms of lamps now before the public, there is room for improvement. There is no such thing as a "best" lamp, we may say, as Prof. Thompson says of the dynamo. One has some points in one direction, while another is superior in other respects. A selective process must be gone through by the electrical engineer, to weed the bad from the good; to learn what to avoid and what to select.

THE DEFINITION OF DIFFERENTIAL.

Since the first articles on differential arc lamps of this series have appeared in THE ELECTRICAL WORLD, some have taken occasion to question the applicability of the term "differential" to such lamps as that of Siemens, or perhaps that of Lacassagne and Thiers.

It is not the first time that electricians disagree about the meaning of that term, which is ambiguous because it may be applied with propriety to distinct sets of conditions. Some electricians are interested in giving to this word a restricted meaning, from the fact that the question of infringement of certain patents is liable to be influenced by the construction of the term.

A good many believe that a lamp is differential only when the derived current produces a magnetic effect on a given armature contrary to that of the main current, as in the Brush lamp; in other words, it becomes a question of "depolarization." But, in my opinion, the manner in which the currents are utilized is only an incidental circumstance. If we use the currents each with its own magnet and its device, one of which tends to make the carbons approach, the other to move them apart, the point of equilibrium at which the action stops is still a differential of the two opposing forces. We might use the currents to produce chemical action instead of magnetism, and yet the resultant action would be a differential of the two. If w had a magnet in one case opposed by a spring, the point oe equilibrium would still be a differential between the spring and the magnet, and a lamp controlled in that way would be a differential lamp, if that magnet were controlled by the derived circuit; for unless this derived circuit were so situated with respect to the main circuit that the amount of current it receives varied with the resistance in the main circuit, there could not be any inter-reaction between the magnet and the spring. This very alteration of power between the main and shunt circuits is a proof of differential action. We might say the action was differential between the spring and the magnet, and this would give the word "differential" a mechanical meaning rather than an electrical or magnetic one.

The four lamps described as differential are, therefore, differential in an electrical sense, and, with some modifications, in a magnetic sense, and they are all necessarily mechanically differential, in a secondary sense.

C. O. M.

Another Electric Signal.

A Louisville inventor, Mr. W. W. Le Grande, has devised an electric railway signal, which is described as follows:

A line of railway is divided into blocks or sections of any desired length; the rails of these sections are metallically connected by means of spring washers placed upon the bolts between the splices and the rails at each rail joint, thus insuring a continuity of metal from one end of a section or block to the other; each block is insulated at its terminals from the others; a line of wire is laid on the telegraph poles and connected to the opposite terminals of each section, or block of rails, thus forming a continuous metallic circuit, with the rails as lapping terminals. A signal post, supporting a circular signal box, is erected at or near the ends of said blocks or sections. A battery-box, or underground battery-cylinder, is also located at this post; a quantity line battery and two relays are placed in the circuit with the above-described line and rails. It will thus be seen that the rails need only to be metallically connected from one to the other at any point on the block to insure the working of the relays. These relays control each a local circuit, in which is placed a local battery and a magnet for moving the signal disk. The signal box is 26 inches in diameter, 10 inches deep, and sets on an iron tripod 16 feet above base of rails.

This box contains a circular mica disk 23 inches in diameter, divided into 12 sections. These sections are colored alternately white and red, and are displayed through corresponding apertures in the box to indicate successively danger and safety. When a train enters a block the quantity circle from rail to rail is closed by means of the wheels and axles of the cars, the relay magnets become energized, which in turn operate their respective locals, thus holding the disks to danger while the train is on any part thereof.

At roads crossing at grade, home and distant signals are erected and placed in circuit with the crossed block, so that visual and audible signals may be given. The inventor claims to have demonstrated in this system that, with the use of a quantity current, the rails and wire may be submerged in mud, water, ice or snow, and will work as a reliable conductor of the electric current without any perceptible leakage. A simple circuit-breaker is placed in each signal-box, controlled by the movement of the disk. This instrument is in circuit with a through line terminating in the train dispatcher's office, where any desired code of signals may be given and recorded.

The New York Electrical Society.

At the meeting of this organization, on the 18th inst., Mr. Walter P. Phillips, general manager of the United Press Association, described his system of steno-telegraphy, a species of short-hand used in transmitting dispatches, which has frequently been referred to in these columns. At the conclusion of his remarks, Mr. D. Boyd, managing director of the Electrical Portable Battery and Gas-Igniting Company, of Manchester, England, was introduced. He exhibited some novelties in induction coils, portable electrical gas-lighters, call-bells, etc. His company, he says, makes use of iron as well as copper wire in the construction of helices, and insulates the convolutions by winding a fine cotton thread between, economy of space being the advantage claimed for this method. Mr. Boyd displayed a small electric scarf-pin, which gives sufficient light to enable the wearer to read the finest print at ordinary reading distance from the eye. The battery which supplies the current for this lamp is carried in the vest pocket. After concluding his remarks he presented the society an electrical portable gas-lighter. The circulating library was inaugurated at this meeting. It is hoped that this feature will increase interest in the society.

THE

ELECTRICAL WORLD,

PUBLISHED WEEKLY AT

No. 9 MURRAY STREET, NEW YORK.

W. J. JOHNSTON, Editor and Publisher.

NEW YORK, MAY 26, 1883.

CONTENTS.

ILLUSTRATED ARTICLES: PAGE.
The Portland Telephone Exchange....323
Electric Lighting—XXVII....324
EDITORIAL:
Electricity and Inventors....326
The Electric Light on Brooklyn Bridge....326
Two Opinions of "THE ELECTRICAL WORLD"....326
The Reporters on the Lighting of the Bridge....326
Testing the Chicago Conduits....327
Further Improvements in the Bichromate of Potash Battery....327
The Western Union Trouble in Illinois....327
An Aggressive Gas Man....327
The National Exposition of Railway Appliances....327
Issuing "THE ELECTRICAL WORLD" Earlier in the Week....327
Subterranean Electrical Lines....327
MISCELLANEOUS:
Another Electrical Signal....325
The New York Electrical Society....325
Subterranean Electrical Lines....328
Some Points in Electric Lighting....329
Voting by Electricity Not New....330
DEPARTMENTS:
Department of Inquiries....330
The Telegraph....330
The Telephone....330
The Electric Light....330
Miscellaneous Notes....331
Electrical Patents Issued....331
Business Notices....331

NEW ADVERTISEMENTS.

In the growth of our paper in circulation, size and general improvement, the value of its columns for reaching those engaged in electrical pursuits or interested in electrical matters has not failed to be appreciated by advertisers. In order to better enable our readers to notice anything new which advertisers may have to offer them, we now give in this column a list of new advertisements as they appear in each number. The following will be found in to-day's issue:

PAGE.
Whiting—"Opera Boxes"....332
Chemist—Employment Wanted....332
American Jewelry Co.—Catalogue of Waltham Watches....332
Maurice Brick—Fine Cigars....332

ELECTRICITY AND INVENTORS.

It is frequently said that ours is the age of electricity. The assertion is quite true. Everywhere electricity is fast becoming the all-inspiring, all-controlling influence. It may be said to be "fashionable" in the extreme just now as the most popular agent at the disposal of man. It fills everybody with interest and curiosity, pretty much as a clever sleight-of-hand performer excites wonder and surprise. That mystic trait of the human mind which thirsts for the enchantment of the wonderful and the mysterious is satiated by the rapid succession of electrical innovations which come to our knowledge every day. And so electricity grows in popular esteem from day to day, its wonderful results only serving to predispose us in its favor and lead us to higher expectations.

At the back of all—behind the scenes—stands the inventor, who is the real magician of the performance. It is to him that we are indebted for this change of sentiment in favor of electricity, once looked upon as merely a dangerous and doubtful experiment. The world owes the electrical inventor a large debt of gratitude for what he has the industries to find interest in its capabilities. The inventor should, therefore, be encouraged, and his tasks should find at all times the ready assistance of friends of the science.

But there is a word to be said about inventors. Perhaps it has never occurred to us before that ours is also the "age of inventors." Yet such is the case. Inventing, as a profession—as a fine art, indeed—is just as popular as electricity itself. As a matter of fact, electricity may be said to have done more than its share to bring about this condition of things, for it is since the age of electricity was inaugurated that it has appeared. There has always been a certain class of "latent" inventors, if we may be allowed so to done in bringing ours to the head of the sciences by forcing express it, and electricity has proven to be just the impulse which their talents needed to foster their development. Electricity is the youngest and most fertile field for effort, and as it has the reputation of being the least "overcrowded," naturally enough it is made the port whither tends a whole tide of "immigration" from other fields of invention. This is unfortunate, for in the majority of cases the men who come into the field from this source are not exactly of the class which is needed. Inventors may be defined somewhat in the same manner that Shakespeare defines greatness; some men are born inventors, some invent for the love of science and progress, others invent for the love of money.

The inventions produced by the first two classes of inventors might also be said to be "achieved," while those produced by the third are more apt to be "thrust" at capitalists. The men who come to us from the neighboring fields are too often of the third class. They are adventurers, "prospectors," in search of gold. They are inventors "by profession," and they usually possess all the conceit that professional dignity can sustain. The "efforts" of these men are not to be deprecated, of course, for it might be argued that they are just as likely as anybody else to hit the nail on the head. But the trouble lies in he fact that they are unprepared to a great extent for the work. They invent, to be sure, just as poets write new idyls on old themes, but in many cases their efforts only serve to "clog" the Patent Office with combinations of mechanism, of themselves more or less useless, and in that way prevent other honest, capable, intelligent inventors from using principles which they are far more competent to apply.

The man who has been blessed by nature with inventive talents ought to be conscientious in the use of them. He should understand his sphere, and out of true respect for his talents he should not pervert them by entering a field for which he is not fitted, just for the sake of satisfying his greed for lucre. In many cases he proves useless to himself and a source of annoyance to everybody else. He should go back to where he belongs and make room for others, more modest than himself but more able, who are willing to fill his place.

On general principles, we deprecate such incursions into the domain of electrical invention by nomadic booty-seekers. We believe the science and the arts which depend upon it would be as thrifty with fewer and better inventors. There is always lots of room at the top. The trouble is there is too much crowding around the bottom of the ladder, so that those who might otherwise prove good men often fail to get a chance to even touch the first round.

The Electric Light on Brooklyn Bridge.

The first experimental test of the electric light installation on Brooklyn bridge was made on Saturday (19th) evening. Everything was found to be in excellent order and the system worked to perfection. The United States Electric Illuminating Company is to be congratulated on its success in carrying out this piece of electrical engineering. The seventy lights are divided into two distinct circuits of thirty-five lights each. There are two separate engines, one for each circuit. This is to lessen the possibility of a general extinction from accident or mishap, for it is not likely that the two engines will be interrupted at the same time. The lights are so distributed on each circuit that in the event of the stoppage of one engine the light produced by the lamps on the other circuit will be equally distributed over the whole bridge. As stated in last issue, the current is at present supplied to these circuits from one of the illuminating stations of the company, on account of the fact that the boilers for supplying the engines are not in place. Each engine will serve to work two twenty-light dynamo-electric machines connected in series which will furnish the current necessary for each circuit. The machines differ from the ordinary arc light machines in the fact that their magnetic fields are wound in derivation. The advantage of using these "shunt dynamos," as they are called, is that the supply of current which they can give adapts itself more or less perfectly to the demand; that is to say, when a number of lights are cut out, either purposely or by accident, the machines then produce only current enough for the lights remaining in circuit, and the power consumed also diminishes correspondingly. The total length of the leading wires is said to be 30,000 feet. The wire used is No. 3 of copper, braided, covered with kerite and painted so as to be absolutely proof against short circuits from contacts at any point with iron-work, and so that they may be protected effectually from water. The conductors are sunk in pipes and masonry along the approaches, and are secreted in wooden boxes along the bridgeway. There are also over 1,000 feet of small wire for the four station lamps.

The lamps are all double, so as to accommodate two sets of carbons, and this will give them a capacity for burning in winter from 4.30 P. M. to 6 A. M. Their light-giving intensity is 2,000 candles (nominal). The lamps are suitably protected by the wire netted globes, and are fastened to ornamental bars projecting from iron posts suitably provided for them. It is said that besides the continuous circuit there is a wire that goes to each lamp separately, and which is used for the purpose of lighting and extinguishing the lights.

Two Opinions of The Electrical World.

Since it "takes all kind of people to make a world"—at least we find all imaginable kinds in the world—many varieties of journals are needed. Even the members of one profession are not all of the same mind as to the merits of a journal published in their interest. It is not expected they would be, since every grade of taste is represented within any class.

A man likes a newspaper or journal exactly in proportion to its suitability to his mind. One man will be delighted with a paper which another has no use at all for, and would not read. It is a mere matter of individual requirement. Both are fond of expressing their opinions to the editor. One flatters him, the other pounces upon him with the animus of a personal foe, and goes to work to reduce his vanity without regard to syntax or ceremony. THE ELECTRICAL WORLD occasionally receives evidence of that warm interest which manifests itself in reproof. The following postal card from a railroad operator in Nebraska, written immediately after the announcement of the recent "subdivision of the current," is a sample:

Send me *The Operator* on the new arrangement. I trust I shall be better pleased with it than I was with *The Operator and Electrical World*. Since subscribing for your paper I have felt so disappointed and disgusted that frequently I was constrained to tell you to discontinue sending it, as it wasn't worth taking from the post-office. Scientific journals are all right in their proper channels. In you our fraternity believed they had an organ and a friend, and so they had until you obtained influence, notoriety and wealth, when you placidly change your bearings and cater to the monopolists and aristocracy. 'Twas ever thus. Such is life.

We are sorry our Western correspondent has so little appetite for science; but time and knowledge may help him in that particular. THE ELECTRICAL WORLD is not published for people who cannot understand it. It does not cater to the class who care nothing for science. It is in demand by those it aims to reach, and it covers the field it was designed to fill, and feels very comfortable in consequence. Side by side with this murmur of displeasure comes a letter from one of the best known and brightest lights in the electrical firmament in Canada, containing this reference to THE ELECTRICAL WORLD, which we print to show how widely divergent are the tastes of people in the same calling:

"You ought to be proud of your success in building up such a splendid publication as THE ELECTRICAL WORLD—one that has no equal in its line anywhere."

As this latter seems to be the sentiment of the electricians of America—we could fill columns with similar encouraging words of praise—and as we feel that THE ELECTRICAL WORLD really is of interest and value to the class of readers for whom it is intended, we are quite content to go on improving it and making it more and more acceptable to such, even if there is another class who prefer light reading to science. The re-establishment of *The Operator* will enable us to satisfy this taste without interfering with the predilections of readers of THE ELECTRICAL WORLD.

The Reporters on the Lighting of the Bridge.

Lighting the Brooklyn Bridge on Saturday evening, the 19th, was an event which gave the numerous reporters of the city press a fine opportunity to soar into lofty poetical altitudes. Each mounted his own private electrical Pegasus and cantered through space regardless of all philological restrictions. One dauntless knight of the pencil penetrated to the mysterious chamber in Elm street where the electricity is generated, and then launched forth in exaggerated description. "The scene," he said, "suggested the subterranean laboratory of a magician." This is a favorite simile with the reportorial fraternity. Not one of them has ever seen the subterranean laboratory of a magician, since magicians are not numerous at the present day, but each one of them knows exactly what it looks like, or thinks he does, which is all the same. Here is the scene as the reporter had it photographed on his mind:

Blue lights burned, invisible engines shook the ground with ponderous stroke, and a dozen grim and anxious men toiled in the ghastly glare. Around these perspiring men stood two or three directors, who were giving orders and hastening the work. Great belts, a yard wide, ran over dynamo pulleys at frightful speed, and eight or ten other pulleys were awaiting new belts which were hanging slack over their shafting. These idle pulleys belonged to the dynamos of the Brooklyn bridge. A man wearing a black suit and a tall beaver hat, who had scarcely spoken a word, finally took out his watch and said, "We shall be ready to try the thing in a few minutes." The belts were adjusted,

and when all was ready the man in the tall hat gave the word and all the dynamos were roaring in a moment. Reporters and visitors stood back to get out of the way of the belts. Everything in the cellar seemed charged with electricity. To touch any of the machinery was to start a spectral blue flame. If one held his fingers near a belt long needles of fire shot from under the nails.

So much for the "subterranean laboratory." From there the reporter moves on to the bridge entrance and up the roadway toward the towers to see the wonderful lights burst from the gloom of night. This, too, was a scene which fired his fancy with fine imagery:

The bridge, which was dark and deserted except at the gate where the watchmen were admitting a squad of electricians, seemed twice as large in the darkness as it ever is in daylight. The great cables, the thousands of wires and cords filling the air overhead, only added to the complicated vastness of the structure. The river gleamed far below, tugs and ferry-boats glided over the silvery pathway as if they were phantom toys in a scene of enchantment. On either hand two great cities stretched away into the night. Suddenly there was a crackle and a flash of noonday light. A grim, greasy man in the Elm street cellar had touched a lever, and for the first time since the world was created electricity spanned the river. The seventy (two-thousand-candle-power) lights blazed over the ship channel like an arch of stars. Steam tugs whistled, men shouted. In New York, Brooklyn, Staten Island, for miles and miles around the two cities, men pointed to the splendid spectacle of lightning at work for man.

Another who did not continue so long on the wing, though he soared as high as his contemporary, describes it thus:

When all was complete, the effect was grand in the extreme. High up in air, dancing hither and thither in the evening winds, the lights looked as if so many planets had suddenly left the sky and were temporarily hovering beneath the vast network of wires that hold up the great structure in midair. Ferry-boats and passing tugs, which looked like miniature craft, tuned their steam whistles, and this latest evidence of the near opening of the bridge was hailed with delight.

Testing the Chicago Conduits.

The event for which the American Sectional Electric Underground Company has been for some months preparing, took place in Chicago on the 12th inst., when a practical test was made of a mile and a quarter of the conduit, newly completed, in the presence of a number of representatives of various electrical companies and members of councils of several of the principal cities.

Among the former who were present were Mr. Elisha Gray; Superintendent Parker of the Postal Telegraph Company; City Electrician Barrett of Chicago; Messrs. H. H. Rebbeck and Henry M. Claflen, of the Cleveland fire-alarm telegraph department; H. G. Fledderman, of the Baltimore fire and police telegraph department; E. S. Patten, chief operator Mutual Union Telegraph Company; and M. C. Babcock, general agent of the Brush Electric Light Company.

When the guests were assembled in the testing room, Mr. W. H. Johnstone, of Philadelphia, president of the American Electric Underground Company, mounted a table and explained to them in a few concise words exactly what the underground conduit of which so much has been heard, is: The conduit is a continuous square main of grooved cast-iron plates, fitted together by overlapping the joints. It is from 4x4 inches to a foot in diameter, and is placed at a depth of two or three feet underground. In the conduit are a number of shelves, made of copper, and it is upon these the wires rest, the local being on the top, and the others below. The capacity of the smallest-sized conduit is one hundred wires, and the top of the main is provided at every twenty-five feet with openings by which access is had to the wires when they need repairs. Mr. Johnstone explained, at some length, the subject of induction or retardation. The absence of interference, he said, was the underground system's strong point. Each of the wires was encased in plumbago or other metallic covering, and this, in connection with the copper shelves, carried off and grounded opposite currents of electricity. The trouble in every large city with overhead wires is foreign sound. Conduit wires could be laid side by side in the main without further covering than a slight metal coating.

According to the local newspapers, the tests were very satisfactory. The *Tribune* says: "Two telephone wires running through the conduit were connected in such a manner as to represent seven miles of wire for each one, and no induction was appreciable. A Morse line had been working through one of the wires in the conduit all of this time, and two more of the conduit wires were utilized by connecting two of the Baltimore & Ohio wires to them.

Then a Van Depoele dynamo, operated by a seven horse-power motor, for sixteen electric lights, was connected through the conduit, and there was no effect felt on the other wires. Finally, about 6:30 P. M., with these wires doing service, each in its individual capacity, the through Postal-wire was attached to a telephone, and New York was talked to with ease, the *Tribune* reporter recognizing the voice of Mr. F. W. Cushing, one of the Postal Company's electricians, with whom he was acquainted."

Mr. Gray was asked privately what he thought of the conduit, and he replied: "I think very well of it." Mr. Parker says it is a decided success in every particular. The electricians of the Western Union Company are very chary of their opinions.

Mr. C. H. Summers, the well-known electrician of the Western Union Telegraph Company in Chicago, says: "I see nothing in this conduit to make it any more efficacious than a simple iron tube would be. In the first place, the idea that a system of underground telegraphy can be demonstrated as a success and adapted to the requirements of telegraph and telephone companies in a single mile of conduit is a mistake. Every electrician knows there are innumerable experiments which work admirably in the laboratory, but fail when put to a practical test, and this appears to be a kind of laboratory experiment. Mr. Johnstone, the president, stated that they had no plan for insulating the wires; that this question was to be worked out by electricians. Now I submit that an underground system without some plan for insulation is not what is wanted, for insulation is an essential necessity which must be the foundation of every system. He claims to have a perfect anti-induction attachment, but upon examination I see nothing but the Foucault system, which has been used by the telephone for three or four years—the wrapping of the conductors with tin-foil. Mr. Johnstone's differs in that he has shelves of copper between the different layers of wires. He does not claim that his plan will prevent induction between wires in the same cable, and does not recommend the use of cables, preferring the use of single wires drawn into the conduit loosely. I do not think any critical tests could be made in a crowd such as attended the exhibition, hence the result, so far as the crowd is concerned, could not have been satisfactory. I see nothing in the system but a simple conduit for wires, and as a protection to them no better than some others which have been brought to notice. In brief, they have not solved the problem of underground telegraphy or thrown any new light upon the subject."

Further Improvements in the Bichromate of Potash Battery.

Bichromate of potash solutions in voltaic batteries have been used so long in electrical work that it is strange the advantage of an excess of the bichromate has not come to light before. The bichromate of potash battery has always been a convenient one, from the fact that it can give rise to very intense currents; but its want of constancy, in consequence of its tendency to polarize, has often debarred it from important applications.

Now that M. Trouvé has given us the simple expedient by means of which its constancy is increased, the battery will doubtless prove of more frequent usefulness. Signor Luigi Ponti has sought to carry the idea further, with a view of bringing the battery to a still greater degree of efficiency. The secret of M. Trouvé's method of preparing the solution appears to lie in the fact that the liquid, becoming heated by the acid, its capacity for dissolving the bichromate of potash becomes increased, as was pointed out in the notice of M. Trouvé's battery which appeared in *The Operator* of May 1. Signor Ponti reasons that by heating the liquid to the boiling point, the amount of bichromate which can be dissolved would be greater, and the results confirm his theory. His formula is:

Boiling Water	3.5 litres (about 7 pints).
Hydrochloric Acid	1.75 litres (about 3½ pints).
Bichromate	1 kilogramme (2 1-5 lbs.)

It will be noticed that hydrochloric acid is used in place of sulphuric acid. The addition of hydrochloric acid to the ordinary solution, with the result of improving it, had already been practiced. Signor Ponti thinks the solution works still better when this acid is used altogether. The table given above shows that the amount of bichromate dissolved is even greater than in the Trouvé solution. It is said that no crystals are deposited by the cooling of the solution, or during the action of the battery. This solution is, of course, applicable to all the forms of carbon and zinc batteries with which bichromate solutions are ordinarily used.

The Western Union Trouble in Illinois.

At Chicago, on May 8, Messrs. Robert C. Clowry, Frederick H. Tubbs, W. K. Morley, Frank C. Ives, Norman Williams and John Thompson filed their plea to the information filed against them six weeks ago by the State's Attorney on the relation of Allan C. Story, requiring them to show cause why they were exercising within the State of Illinois the liberties and franchises of an alleged corporation styling itself the Western Union Telegraph Company. The plea sets up that the Western Union Telegraph Company is a regularly incorporated company under and by virtue of the laws of the State of New York, and has been recognized as such by the judicial, legislative and executive branches of the government of that State. It claims that the company is lawfully transacting its business and exercising its corporate rights and privileges in the State of Illinois by virtue of its incorporation under the laws of the State of New York. As for the defendants, personally, the plea says that they are simply employés and agents of the company, and that it can not be said that they are exercising the liberties and franchises of the company when they are simply obeying the orders of its execution.

The State's Attorney filed instanter a general and special demurrer to this plea. The special defects in the plea were said to be: 1. That it was neither a disclaimer nor did it show any right to the franchises mentioned in the corporation. 2. It was an evasion, being partially a justification and partly a denial. 3. It alleges conclusions of law and sets forth no facts upon which issue can be joined. 4. It makes no answer to the information. 5. It neither wholly admits nor wholly disclaims the usurpation charged. This demurrer was argued forthwith before Judge Gary, Mr. Story representing the State's Attorney and Gen. Thompson representing the respondents. The result was that the Court sustained the demurrer, but gave the respondents leave to file additional pleas.

An Aggressive Gas Man.

The rapid progress of the electric light is undoubtedly exasperating to holders of gas stocks, but they ought not to allow their feelings to carry them to the extreme of chopping down electric light poles. That is a method of competition the futility of which was long ago demonstrated in telegraphy, and has just been illustrated again by a Dayton (Ohio) gas director. The electric light company in Dayton was established four months ago, and has met with great success, having recently ordered a large additional number of Fuller lamps, to meet the increasing demand. This has caused bad feeling among the gas men, which led to a ridiculous occurrence on May 18. The story is thus told by a Western paper: "A few days ago the electric light company erected a pole, on which to run their wire, in front of a big business block in the centre of the city, which belongs to John Harries, a director of the gas company, and probably the wealthiest citizen in Dayton. Mr. Harries issued an injunction, but too late to prevent the erection of the pole. He said at the time he would cut the pole down, and at 4:30 o'clock this morning, while the police were at roll call, he carried out his threat, wielding the ax with his own hands. As the pole fell, two officers turned around a corner about a square distant and called to Mr. Harries to halt. Mr. Harries ran and the officers gave chase, overtaking him about six squares distant. He offered one of his captors his note or check for any amount he desired for his release, but was taken to the station-house, and in default of $50 bail, in cash, was locked up until he succeeded in borrowing the desired amount. He was charged with malicious destruction of property. Mr. Harries is sixty-five years old, and not only a very wealthy citizen, but a public-spirited one.

The National Exposition of Railway Appliances.

This exposition will be held at Chicago from May 24 to June 23, in the Inter-State Exposition Building. It need scarcely be said that electricity and electricians will both be well represented there. Although electricity has only offered itself hitherto as an assistant, a supernumerary, in railroad enterprise, yet it has found encouragement and appreciation. Its adaptation as a means of signaling has proven a boon by the certainty of its action where other means have failed to prevent disasters. Electricity has shown itself more ambitious of late, and the electric railroad system that will be exhibited there will no doubt awaken universal interest among all who visit the exposition. It is well known also that the electric light aspires to fill a place as an illuminant in railroad trains, and it promises to shine there more brilliantly than ever. There will be a representation of all the prominent systems of arc and incandescent lights to interest the visitor. Even the telephone will not be forgotton in this display of useful appliances wherein electricity is to be the active agent. On the whole, the exhibition will be of considerable interest to the electrician. Many an electrical inventor will probably find there the germ of a valuable idea, by being brought into more intimate contact with the objects of his study. That electricity could have so soon filled a secondary part on the programme of an exhibition of one of the greatest industries in the country, would have been a source of surprise. That it has done more, and occupies a place of higher importance, will be a source of pleasure and satisfaction to us all.

Issuing the Electrical World Earlier in the Week.

This number of THE ELECTRICAL WORLD goes to press a little earlier than usual. The object we have in view is the very commendable one of mailing the paper in future in time to have most of its subscribers always receive their copies during the week in which they are published. We are sure that all will appreciate this.

In this progressive electric age last week's paper seems stale and not half so interesting as it would had it come to hand on even the Friday or Saturday of the week in which it was issued.

Subterranean Electrical Lines.

In view of the movement now on foot to place telegraph wires under ground, no doubt the article we publish today on the above subject by Professor Van der Weyde will be read with interest. It gives much historical information, and shows that it is not a new experiment, but that the problem has been satisfactorily solved in other countries, especially in Germany.

Subterranean Electrical Lines.

BY P. H. VAN DER WEYDE, M. D.

It is self-evident that the many atmospheric disturbances to which telegraph and telephone air lines are subject are entirely avoided by the adoption of subterranean cable systems.

By their concealment the wires are safer from mischievous interference, while accidental injuries, so common in air lines, are exceptional in subterranean cables. There is no stretching of the wires, hence they are not liable to be broken by excess of tension, by their own weight, by the wind, or by adhering icicles, which latter cause of interruption, not infrequent throughout the country, is the source of much trouble and very large expense.

It is possible to transmit messages along a good subterranean wire, whatever be the condition of the weather, which is by no means the case with air lines, which are subject to all kinds of atmospheric disturbances. The loss of the current in rainy weather, which renders the use of increased battery power a necessity; the obtaining of too much current during thunder storms, in some cases to a degree endangering the lives of operators; auroral interferences, etc., might be mentioned as examples.

The cost of construction of subterranean lines is considerably more than that of air lines, but this is compensated for by their greater durabilty. Air lines involve incessant expenses, such as the rotting of the poles, breakage of the insulators, rusting and deterioration of the conducting wires, often necessitating entire renovation. For these reasons a continual expense for supervision and repair is necessary; so that, all things considered, it is no longer doubted in Europe (in Germany, for instance, where the subterranean system has been extensively tested) that the underground method is the most economical and efficient.

By the continually increasing network of air lines, the confusion of wires and poles, becomes daily greater; as also the difficulties of obtaining a reliable insulation, while the disturbances and interruptions by accidents of all kinds become daily more frequent.

The idea of using subterranean conductors was undoubtedly first conceived by Lesage, of Geneva, Switzerland. In 1774 he used glazed earthernware tubes containing partitions of glass in which there were holes for the wires to pass through. In 1794 Reisser and Böckman in Cassel, Germany, proposed improved subterranean conductors; while Ronalds, in England, in 1816, passed the wire through glass tubes, the insulation of which he made still more thorough by placing them in long wooden troughs filled with pitch. A remnant of one of his subterranean telegraph wires which had escaped destruction was seen at the Paris Electrical Exhibition of 1881.

Jacobi, in Russia, in 1841, made an experiment by inclosing a wire 8,500 feet long in glass tubes, connecting the ends with an insulating cement, and burying the tube under one of the streets of St. Petersburg. In the following year he extended this system from the latter city to Zarskoeselo. The results were not quite satisfactory; while other attempts to use rubber bands wound around the wire failed entirely. It was the same in England and in the United States, where insulation was attempted by means of varnished cotton coverings enclosed in iron or lead tubes, in order to keep out all moisture. This insulation was found defective.

Siemens, in Berlin, in 1846, made the first successful attempt to obtain perfect insulation by means of gutta-percha, which had then just become an article of trade, and which he found to be one of the best insulating substances known, having the valuable property of elasticity, while easily rendered plastic by heat, a most valuable property in the process of covering the wire. For this process many mechanical contrivances were invented which have attained great perfection since that time.

As the results were very favorable, the Prussian government concluded in 1846 to introduce gutta-percha covered wire for subterranean lines on a large scale, and succesively constructed a length of 1,300 miles, which at first rendered excellent service during the threatening political conditions of that period. Unfortunately the insulation gave out after a very short time, which was due to different causes. First, the gutta-percha had been mixed with sulphur, which improved it at first, but diminished its durability; the machinery for covering the wire was still imperfect, and the haste with which the government had pushed the matter through, for political reasons, caused imperfections both in the preparation and laying of the cable. It was found that the sulphur in the covering combined with the copper and formed sulphuret of copper, and that the electric current passing through the wire decomposed this compound and changed the covering into an incoherent, porous mass, readily penetrated by the moisture of the ground, so that the insulation was finally destroyed. It was also found that the insulating covering had not been applied equally, so that the wire in many places approached the sides of the cable so closely as to be very nearly exposed at the surface, which places, of course, gave out first. It was also found that the covering contained air bubbles, which may have resulted from want of sufficient care in the process of covering, as well as from the use of inferior material. Moreover, the wires were found to have been buried to an insufficient depth, only twelve to fifteen inches below the surface; a depth of four feet, at least, having since been adopted. It was also found that in some places the covering had been injured by spades in digging, and also by burrowing animals. All this did not prove that the subterranean system was wrong, but merely that the work had been defective.

THE CONDUCTING CORE.

For subterranean and submarine telegraph cables copper wire is preferred, for various reasons: It withstands rusting better than iron wire and, being six times the better conductor, it requires to be only one-sixth of the weight for the same conductivity. As copper has only about half the tensile strength of iron, the latter is preferred for air lines, being at the same time much less expensive. However, as durability may offer a full compensation, and the business to be transacted justifies the greater outlay, a copper air line may be far preferable. It has been recently brought into use by the Postal Telegraph Company, which has constructed a copper air line from New York to Cleveland and has recently extended it to Chicago. The precaution has, however, been taken to strengthen it by a core of steel wire (steel being three times as strong as copper), while drawn steel wire is stronger still. This steel wire is surrounded by copper precipitated upon it by the electro-plating process, securing a pure copper, which is one of the chief advantages of that method, because the conductivity of copper depends very much upon its purity and diminishes very much by the alloy of even a comparatively small amount of any other metal. It is obvious that copper wires several miles in length are likely to have weak spots at various intervals which may result in a fracture; therefore, it has been determined not to use a single wire subterranean or submarine cable, but instead to make a compound conductor of from three to seven thinner copper wires twisted together to form a single strand. The subterranean cables of the German Empire are made of a strand of seven copper wires of No. 22 B. W. G., of which the total resistance is a little less than ten ohms per mile, and nearly equivalent to No. 6 or 7 iron wire. It is evident that, if any of these seven wires breaks, the continuity of the current is not interrupted, as they are in mutual contact over their whole length.

INSULATION OF THE CONDUCTOR.

For insulating material pure gutta-percha or rubber is now used in Germany, and in some special cases asphaltum. The gutta-percha is softened by steam heat, and by special machinery is pressed around the strand of copper wire, in which operation it is important to take care that the conducting wire is held always in the centre of the covering, and kept free from air bubbles. When rubber is used for covering, the wire is wound around with a flat strip of rubber in such a way that each layer overlaps the other halfway; or the wire is passed between rollers with two strips of rubber, one at each side, so that the rollers cut the edges of the strips, and as freshly cut rubber edges adhere under pressure, a single layer applied in this way furnishes a complete covering. Nevertheless the operation is repeated, and the precaution is taken to cause the seams of the second covering to be at 90° distance from those of the first. In France it is customary now to connect the central offices with the separate stations in the same city by means of a trough filled with asphaltum in which the bare wire is placed.

CHARACTER OF INSULATING MATERIALS.

Gutta-percha is the concentrated gum of a tree called by botanists the *Icosandra gutta*, growing in Java, Borneo and other localities in East India. It grows to the height of seventy or eighty feet and six to seven feet in diameter. Its insulating capacity diminishes largely with increase of temperature. For instance, at 80° Fahr., it becomes at least twenty times less than at the freezing point.

In sea-water it remains unchanged for a long time. When dredged up from the bottom after fifteen years' immersion, it was found to be perfectly fresh and of unchanged insulating capacity. On the other hand, when exposed to the air and heat it deteriorates rapidly. For this reason, the covered wire must be placed under water and kept in a dark and cool place immediately after being finished.

Experience obtained from various trials has shown that the insulating quality of gutta-percha improves when sunk at a great depth, and this by the pressure of the superincumbent mass of water, and that the surface layer only is slightly affected.

Rubber kautschuk or caoutchouc is also the product of various tropical plants, such as the *Siphonia cahuca* from South America; the *Aeories Arvensis* of East India, some varieties of *Ficus*, etc. At 390° Fahr. it melts to a thick liquid, and, being decomposed, does not become solid by cooling. Its insulating capacity is still better than that of gutta-percha, and does not diminish so much by increase of temperature; but its durabilily under water is far inferior. The latter peculiarity and its want of plasticity has made its applications for the insulation of telegraph wire much more limited. A combination of rubber with sulphur and other substances, by a process called vulcanizing, has resulted in the manufacture of hard rubber, known in various countries under different names, such as vulcanite, ebonite, horn gum, comb material, etc. It is a very useful compound for the manufacture of several electrical appliances, possessing as it does excellent insulating properties, and having a degree of elasticity almost equal to steel, and being readily worked with cutting tools. Hooper's insulating compound is chiefly gutta-percha. He manufactured, in 1866, insulated wire of very good quality on a large scale, and attained a favorable reputation. At present he has perfected his method so much that his products are preferred over gutta-percha covered wires. He found that the contact of the copper with the gutta-percha has an injurious influence upon the latter; and, therefore, he covers the copper wires first with tin. The tin-plated strands are then first surrounded with a spiral strip of rubber. Over this he places a layer of a compound consisting of ¾ rubber and ¼ oxide of zinc, also wound spirally, and on this a composition of four parts of rubber, six of sulphur and ten of sulphuret of lead. This covering is not applied spirally but in two strips, of which the edges are freshly cut and united by pressure.

The last layer is not so much intended for improvement of the insulation as for the protection of the inner layers against the oxidizing action of air and water. A final spiral covering of a cotton strip keeps the last covering together, and prevents any possible loosening or separation of the same.

Thus prepared, the wire is wound on bobbins, and placed in hermetically closed iron cylinders filled up with pulverized chalk, and exposed to a temperature of 290° Fahr., with a pressure of three atmospheres. The chalk prevents the sticking together of the coils and unequal heating; the inner insulating layers are baked together to a homogeneous mass, while the second layer prevents the penetration of the sulphur to the first insulating covering. As the Hooper wires can stand a temperature of 140° Fahr. without injury to the insulation, and as the insulation is better than the gutta-percha-covered wire, it is especially adapted and used for telegraph lines in tropical regions.

PROTECTION FOR SUBTERRANEAN WIRES.

Experience soon demonstrated the fact that wires covered with gutta-percha or rubber are subject to various kinds of injury when they are placed in the ground without further protection. The insulating covering becomes more brittle, and is attacked by rats, mice or moles, and is frequently cut by spades. The first protection against this was to place the wires in wooden troughs, after surrounding them with tarred hemp, but it proved inefficient against moisture, rodents, etc. The next process was to place them in lead pipes, or rather to draw lead over them, in the same way that copper wire is surrounded with gutta-percha; but this process also proved a failure, because the carbonic acid in such kinds of soils as are rich in vegetable matter soon attacks the lead and forms carbonate of lead, or white lead, which becomes a powder and exposes the gutta-percha. The third process was to pass iron tubing around the wires, but this was abandoned, as it was found that during the placing of the wires in them they were liable to be damaged more or less. The process finally adopted was to unite several insulated strands of wires to a cable, which is then surrounded with spiral strands of stout iron wire.

THE SUBTERRANEAN CABLES OF THE GERMAN EMPIRE.

The expensive failures which had been experienced in Prussia with the first cables induced experts to seek for improvements, which have led to favorable results. It was more especially the prudence, energy and perseverance of the creator of the International Postal Union, Dr. Stephans, which brought about the completion of the subterranean cable system which now connects Berlin with the principal cities of Germany, and each one with the other. According to the report recently presented by Dr. Stephans before the session of the Electrical Association, 221 German cities are connected for a distance of over 3,000 miles, while the total length of subterranean telegraph line is 25,000 miles. Seventy cables across the larger rivers of Germany being together 40,000 feet. The length of each section of cable is about 4,000 feet, and they are united by some 5,000 connections. The weight of all the subterranean cables laid is, therefore, thirty millions of pounds; the iron covering twenty-two millions and the copper wire two millions. Thus far sixty months' labor have been spent, while the total expense was four millions of dollars.

In order to determine the question in regard to the improved construction to be adopted, and as to dimensions and other details, the State Directory of Telegraphy appointed a committee, which met in 1875, and after consultation with experts of various nations, especially from England, agreed upon all details. The execution was entrusted partially to the firm of Felton & Guilleaume, of Mülheim on the Rhine, near Cologne, and Siemens & Halske, of Berlin. The first firm made the following cables:

1. Between Berlin and Halle, 7 strands of wire, 100 miles.
2. Between Halle and Frankfort, 7 strands of wire, 240 miles.
3. Between Halle and Leipsig, 7 strands of wire, 20 miles.
4. Between Frankfort and Mayence, 7 strands of wire, 20 miles.
5. Between Berlin, Hanover and Cologne, 7 strands of wire, 420 miles.
6. Between Cologne, Elberfeld and Bremen, 4 strands of wire, 30 miles.
7. Between Cologne, Coblentz and Metz, 7 strands of wire.
8. Between Metz and Strasburg, 7 strands of wire, 120 miles.

The firm of Siemens & Halske in Berlin has manufactured the following lines:

1. Between Berlin and Hamburg (No. 1), 7 strands, 200 miles.
2. Between Berlin and Hamburg (No. 2), 7 strands, 200 miles.
3. Between Hamburg and Kiel, 7 strands, 65 miles.
4. Between Hamburg and Cuxhaven, 4 strands, 80 miles.
5. Between Hamburg and Emden, 7 strands, 18 miles.
6. Between Bremenhaven and Welhelmshaven, 4 strands, 40 miles.
7. Between Berlin and Dresden, 7 strands, 150 miles.
8. Between Frankfort and Strasburg, 7 strands, 170 miles.

LAYING OF SUBTERRANEAN CABLES.

For laying a cable three sets of workmen are brought into requisition. The two largest dig up the ground and the other fills in again when the cable is laid. Between these two larger sets, a smaller one, the layers, proceed. They employ a peculiar wagon, which contains a large drum on which the cable is wound and which unrolls it while the wagon proceeds. At first this wagon was followed by the asphalt car, through which the cable passed; but, notwithstanding the fact that this worked well, it was found to be more convenient to put on the asphalt covering in the factory before the cable is delivered, by which the laying is simplified and time saved. When two ends are spliced, the splicing is tested in regard to insulation and a piece of iron tubing, previously prepared, slipped over the spliced spot—which is also done when some obstruction prevents its being laid at a sufficient depth. The same plan was also adopted at river crossings, where cast iron pipes, each about two feet long, are connected so as to form a flexible strong tube, which to some extent protects the cable against rupture by ship anchors.

We have given the above details, being confident that the knowledge of them may be timely and useful at the present day.

Some Points in Electric Lighting.

BY DR. JOHN HOPKINSON, F.R.S., M. I. C. E.

We reproduce from the London *Electrician* the following abstract of the interesting lecture delivered by Dr. Hopkinson before the Institution of Civil Engineers on April 20:

The science of lighting by electricity was divided by the lecturer into two principal parts—the methods of production of electric currents, and of conversion of the energy of those currents into heat at such a temperature as to be given off in radiations to which the eye was sensible. The laws known to connect together those phenomena called electrical were essentially mechanical in form, closely correlated with mechanical laws, and might be most aptly illustrated by mechanical analogues. For example, the terms "potential," "current" and "resistance," had close analogues respectively in "head," "rate of flow," and "co-efficient of friction" in the hydraulic transmission of power. Exactly as in hydraulics head multiplied by velocity of flow was power measured in foot pounds per second or in horse-power, so potential multiplied by current was power and was measurable in the same units. Again, just as water flowing in a pipe had inertia and required an expenditure of work to set it in motion, and was capable of producing disruptive effects if that motion were too suddenly arrested, so a current of electricity in a wire had inertia; to set it moving, electro-motive force must work for a finite time, and if arrested suddenly by breaking the circuit the electricity forced its way across the interval as a spark. Corresponding to mass and moments of inertia in mechanics there existed in electricity co-efficients of self-induction. There was, however, this difference between the inertia of water in a pipe and the inertia of an electric current—the inertia of the water was confined to the water, whereas the inertia of the electric current resided in the surrounding medium. Hence arose the phenomena of induction of currents upon currents and of magnets upon moving conductors—phenomena which had no immediate analogues in hydraulics.

The laws of induction were then illustrated by means of a mechanical model devised by the late Professor Clerk Maxwell.

In the widest sense, the dynamo-electric machine might be defined as an apparatus for converting mechanical energy into the energy of an electro-static charge, or mechanical power into its equivalent electric current through a conductor. Under this definition would be included the electrophorus and all frictional machines; but the term was used in a more restricted sense for those machines which produced electric currents by the motion of conductors in a magnetic field, or by the motion of a magnetic field in the neighborhood of a conductor. The laws on which the action of such machines was based had been the subject of a series of discoveries. Oersted discovered that an electric current in a conductor exerted force upon a magnet; Ampère that two conductors conveying currents generally exerted a mechanical force upon each other; Faraday discovered—what Helmholtz and Thomson subsequently proved to be the necessary consequence of the mechanical reactions between conductors conveying currents and magnets—namely, that if a closed conductor moved in a magnetic field, there would be a current induced in that conductor in one direction, if the number of lines of magnetic force passed through the conductor was increased by the movement, in the other direction if diminished. Now, all dynamo-electric machines were based upon Faraday's discovery. Not only so, but however elaborate it might be desired to make the analysis of the action of a dynamo-machine, Faraday's way of presenting the phenomena of electro-magnetism to the mind was in general the best point of departure. The dynamo-machine, then, essentially consisted of a conductor made to move in a magnetic field. This conductor, with the external circuit, formed a closed circuit in which electric currents were induced as the number of lines of magnetic force passing through the closed circuit varied. Since, then, if the current in a closed circuit was in one direction when the lines of force were increasing in number, and in the opposite direction when they were diminishing, it was clear that the current in each part of such circuit which passed through the magnetic field must be alternating in direction, unless indeed the circuit was such that it was continually cutting more and more lines of force, always in the same direction. Since the current in the wire of the machine was alternating, so also must be the current outside the machine, unless something in the nature of a commutator was employed to reverse the connections of the internal wires in which the current was induced, and of the external circuit. There were, then, broadly two classes of dynamo-electric machines; the simplest, the alternating-current machine, where no commutator was used; and the continuous-current machine, in which a commutator was used to change the connection with the external circuit just at the moment when the direction of the current would change. The theory of the alternate-current machine was then explained, and it was proved that two independently driven alternate-current machines could not be worked in series, but that they might be worked in parallel circuit, and hence were quite suitable for distribution of electricity for lighting without the necessity of providing a separate circuit for each machine.

It was easy to see that, by introducing a commutator revolving with the armature in an alternate-current machine, and so arranged as to reverse the connection between the armature and the external circuit just at the time when the current would reverse, it was possible to obtain a current constant always in direction; but such a current would be far from constant in intensity, and would certainly not accomplish all the results obtained in modern continuous-current machines. This irregularity might, however, be reduced to any extent by multiplying the wires of the armature, giving each its own connection to the outer circuit, and so placing them that the electro motive force attained a maximum successively in the several coils. A practically uniform electric current was first commercially produced with the ring armature of Pacinotti, as perfected by Gramme. A dynamo-machine was not a perfect instrument for converting mechanical energy into the energy of electric current. Certain losses inevitably occurred. There was the loss due to friction of bearings, and of the collecting-brushes, upon the commutator; there was also the loss due to the production of electric currents in the iron of the machine. When these were accounted for, there remained the actual electrical effect of the machine in the conducting wire; but all of this was not available for external work. The current had to circulate through the armature, which inevitably had electrical resistance; electrical energy must, therefore, be converted into heat in the armature of the machine. Energy must also be expended in the wire of the electro-magnet which produced the field, as the resistance of this also could not be reduced beyond a certain limit. The loss by the resistance of the wires of the armature and of the magnets greatly depended on the dimensions of the machine. To know the properties of any machine thoroughly, it was not enough to know its efficiency and the amount of work it was capable of doing; it was necessary to know what it would do under all circumstances of varying resistance or varying electro-motive force; and, under any given conditions, what would be the electro-motive force of the armature? Now, this electro-motive force depended on the intensity of the magnetic field, and the intensity of the magnetic field depended on the current passing round the electro-magnet and the current in the armature. The current then in the machine was the proper independent variable in terms of which to express the electro-motive force. The simplest case was that of the series-dynamo, in which the current in the electro-magnet and in the armature was the same, for then there was only one independent variable. The relation between electro motive force and current might be most conveniently expressed by a curve.

When, four years ago, the lecturer first used such a curve (since named by Deprez the "characteristic curve") for the purpose of expressing the results of his experiments on the Siemens dynamo-machine, he pointed out that it was capable of solving almost any problem relating to a particular machine, and that it was also capable of giving good indications of the results of changes in the winding of the magnets, or of the armatures of such machines. The use of the characteristic curve was illustrated with reference to charging accumulators and Jacobi's law of electric transmission of power.

When the dynamo-machine was not a series-dynamo, the current in the armature and in the electro-magnet, though possibly dependent upon each other, were not necessarily equal, but the problem was not so simple. In that case there were two variables, the current in the electro-magnet and the current in the armature; and the proper representation of the properties of the machine would be by a characteristic surface, of which a model was exhibited. By the aid of such a surface any problem relating to a dynamo-machine could be dealt with, no matter how its electro-magnets and its armature were connected together. Of course, in actual practice the model of the surface would not be used, but the projections of its sections.

The properties of a machine depended much upon its dimensions. Suppose two machines, alike in every particular, excepting that the one had all its linear dimensions double that of the other. The electrical resistances in the larger machine would be one-half those of the smaller. The current required to produce a given intensity of magnetic field would be twice as great in the larger machine as in the smaller. The comparative characteristic curves of the two machines, when driven at the same speed, were shown in a diagram. The two curves were one the projection of the other, having corresponding points with abscissae in the ratio of one to two, and the ordinates in the ratio of one to four. At first sight it would seem that the work done by the larger machine should be thirty-two times as much as that which would be done by the smaller. Practically, however, no such result could possibly be attained, for many reasons. First, the iron of the magnets became saturated, and consequently, instead of eight times the electro-motive force, there would only be four times the electro-motive force. Secondly, the current which the armature could carry was limited by the rate at which the heat generated in the armature could escape. Again, the larger machine could not run at so great an angular velocity as the smaller one. And lastly, since in the larger machine the current in the armature was greater in proportion to the saturated magnetic field than in the smaller one, the displacement of the point of contact of the brushes with the commutator would be greater. Shortly, the capacity of similar dynamo-machines was pretty nearly proportionate to their weight, that was, to the cube of their linear dimensions. The work wasted in producing the magnetic field was directly as the linear dimensions; and the work wasted in heating the wires of the armature was as the square of the linear dimensions.

A consideration of the properties of similar machines had another important practical use. Mr. Froude was able to control the design of ironclad ships by experiments upon models made in paraffine wax. It was a much easier thing to predict what the performance of a large dynamo-machine would be from laboratory experiments made upon a model of a very small fraction of its dimensions. As a proof of the practical utility of such methods, the lecturer stated that by laboratory experiments he had succeeded in greatly increasing the capacity of the Edison machines, without increasing their cost, and with a small increase of their percentage of efficiency, remarkably high as that efficiency already was.

The electric properties of the electric arc were experimentally illustrated; in particular it was shown that the difference of potential between the carbons was nearly independent of the current.

When a current of electricity passed through a continuous conductor, it encountered resistance, and heat was generated, as shown by Joule, at a rate represented by the resistance multiplied by the square of the current. If the current was sufficiently great, heat would be generated at such a rate that the conductor would become incandescent and radiate light. Attempts had been made to use platinum and platinum iridium as the incandescent conductor. But these bodies were too expensive for general use, and besides that, refractory though they were, they were not refractory enough to stand the high temperature required for incandescent lighting, which should be economical of power. Commercial success was not realized until very thin and very uniform threads or filaments of carbon were produced and inclosed in reservoirs of glass, from which the air was exhausted to the utmost possible limit. Such were the lamps made by Mr. Edison, with which the Institution was temporarily lighted. The electrical properties of such a lamp were examined, and in particular it was shown that its efficiency increased and its resistance diminished with increase of current.

The building was lighted by about 230 lamps, each giving sixteen candles light, produced each by seventy-five watts of power developed in the lamp. To produce the same sixteen candles light in ordinary good flat-frame gas-burners, would require between seven and eight cubic feet of gas per hour, contributing heat to the atmosphere at the rate of 3,400,000 foot-pounds per hour, equivalent to 1,250 watts, or nearly seventeen times as much heat as the incandescent lamp of equal power.

At the present time, lighting by electricity in London must cost something more than lighting by gas. What were the prospects of reduction of this cost? Beginning with the engine and boiler, the electrician had no right to look forward to any marked and exceptional advance in their economy. Next came the dynamo. The best of these were so good that there was little room for economy in the conversion of mechanical into electrical energy; but the prime cost of the dynamo-machine was sure to be greatly reduced. Hope of considerably increased economy must be mainly based upon probable improvements in the incandescence lamp, and to this the greatest attention ought to be directed. It had been shown that marked economy of power could be obtained by working the lamps at high pressure, but then they soon broke down. In ordinary practice, from 140 to 200 candles were obtained from 1 horse-power developed

in the lamps, but for a short time he had seen over 1,000 candles per horse-power from incandescence lamps. The problem, then, was so to improve the lamp in details that it would last a reasonable time when pressed to that degree of efficiency. There was no theoretical bar to such improvements, and it must be remembered that incandescence lamps had only been articles of commerce for about three years, and already much had been done. If such an improvement were realized, it would mean that it would be possible to get five times as much light for a sovereign as could be done now. At present electric lighting would succeed commercially where other considerations than cost had weight. Improvements in the lamps were certain, and there was a probability that these improvements might go so far as to reduce the cost to one-fifth of what it now was. He left the meeting to judge whether or not it was probable, nay, almost certain, that lighting by electricity was to be the lighting of the future.

Voting by Electricity not New.

To the Editor of The Electrical World:

SIR: The idea of voting by an electrical machine, as referred to in the two last numbers of THE ELECTRICAL WORLD, is not new, neither should the French be credited with its first production. Twenty years ago, my father made for Messrs. F. J. and Geo. H. Grace such a machine, and it was taken to Washington to be shown to Congress. Although it was perfect and simple in its workings, the inventors met with such poor encouragement—being told by Schuyler Colfax, then Speaker, that "shortening the time of taking votes was not desired by the majority, and the minority could not secure the introduction of a machine to accomplish it"—that they soon abandoned all attempts to introduce it. CYRUS PROSCH.

NEW YORK, May 21, 1883.

DEPARTMENT OF INQUIRIES.

22. TROUBLE WITH THE HOLZ MACHINE.

I have made a Holz machine with two glass plates, and find great trouble in saving the plates whole. After boring an inch hole through them and cutting them round, I cement them to the walnut spindle faced with vulcanized fibre 2½ inches in diameter, leave them for twenty-four hours and find then that they have started to crack toward the circumference. I would like to know if one such crack will spoil the effects of the plate; if so, would a little shellac varnish remedy it; would it be advisable to varnish the plates *all over* with shellac varnish? The handles to discharging rods are made of a piece of vulcanite tube, cemented to the brass rod about one inch long and then a walnut handle 2½ inches long joined to the vulcanite. Will these handles be safe for a six-inch spark; and what is the longest spark a person may receive without injury? B. W.

DETROIT, Mich.

You have gone through a very common experience in regard to cracking the glass plate, starting from the centre. If the whole has not been ground smooth so as to preserve even edges, the danger of starting a crack at any rough point is very great, especially if you cement the plate to the spindle. The better way is to fix it without cement. This may be done by turning the spindle with a flange against which the glass plate rests, being pressed by a wooden nut screwing on the spindle and bearing against the other side of the glass. A thickness of paper or of cloth may be interposed to correct any unevenness of surface that might tend to make the pressure abnormal at any point and render the cracking more liable to occur. We have noticed that when the hole is bored in a lathe using turpentine and camphor (mixed) to soften the glass, the edges of the hole are smoother and the plate is less liable to crack. A crack once started is sure to extend to the circumference in the course of time. We have sometimes succeeded in arresting it for a long time by boring a hole a little beyond the end of the crack, but ultimately the glass broke any how. The crack will not spoil the effect much, and if you think it does, a little shellac varnish is advisable. Experts in this line, men who make the manufacture of Holz machines a specialty, disagree as to the advisability of varnishing the plates all over; some do it, and others disapprove of it. One thing is certain, the varnish makes the plates much less sensitive to atmospheric moisture than the bare glass. If we understand correctly the piece of vulcanite tube is one inch long, the walnut handle 2½ inches, making 3½ inches. Such a handle is only safe for a two or three inch spark, as along the surface of insulators the spark passes over a greater distance than through the free air. For a six-inch spark the handles should be long enough to keep the hands at a distance of eight inches to avoid the sparks drawn from the machine by outside conductors. A charge giving six-inch sparks between the positive and negative conductors of the same machine, will only give about half that length to outside objects. The danger to injury by a spark does not depend on its length. We have received sparks two feet long, and they do not affect one as much as the spark of a Leyden jar scarcely half an inch long, if one hand receives the spark and any other part of the body is connected with the outer coating of the jar. A one-inch spark of an induction coil is more powerful than a six-inch spark from a Holz machine. Greater sparks have often been received by some oversight from very large induction coils without injury, though with much surprise.

Prof. Van der Weyde informs us that he once experimented on a person who desired to test his capacity to withstand the action of a large Ruhmkorff coil giving sixteen-inch sparks. Beginning with a spark two inches long, the action was increased until the spark attained a length of nearly thirteen inches before the person experimented upon had reached the limit of his endurance. The longest spark of any friction or Holz machine could not do much harm, because the volume of electricity it contains is so small. If this electricity were allowed to accumulate in a Leyden jar or a condenser of any kind, then its discharge would probably produce serious results on the human system, because the quantity of electricity delivered at one movement would be greater. The current given by dynamo-electric machines is of lower tension, but of far greater volume than that given by friction machines. The current of a dynamo-electric machine capable of producing a spark only two inches long would be injurious, perhaps fatal, to a person experiencing its effects. Death appears to be caused by the chemical changes (electrolytic) which the current induces, and the power of the current to determine these changes depends directly on the volume of the current.

23. WINDINGS LECTRO-MAGNETS.

Can you give me a description of a cheap arrangement for winding electro-magnets?

HOWARD, N. Y. NEW SUBSCRIBER.

The simplest arrangement is to mount the spool or bobbin on a spindle placed on two small supports, a crank being attached to the spindle by which to turn the bobbin. Then, by turning the crank with one hand and guiding the wire with the other, the spool may be filled evenly and neatly, particularly if a little patience is exercised in the work. When the wire comes in the form of coils instead of being wound on reels it should be placed on a revolving frame, that it may wind off without kinking and snarling. When the wire is very fine, the most convenient and rapid method is to wind in a lathe. A foot lathe may be used for this purpose, or any contrivance that gives the required speed. A large wheel on the crank-shaft might be geared or belted to a smaller wheel, and thus give the increased speed. What is most desirable in the apparatus is that it shall stop quickly, for oftentimes the wire jumps over and rides on the upper layer, and then the motion should be stopped instantly in order to unwind this faulty portion. In factories the power lathe is used extensively. The clutch on the countershaft used permits almost instant stoppage. As a rule, however, no attempt is made to wind too fast, on account of the difficulty of guiding the wire accurately. It is quite a feat to guide the wire so as to make it lie close and even. It is better not to hold the hand guiding it too near the spool. Strange as it may seem, the tendency of the wire to ride over is greater than when the hand is held at a distance of eight inches or more with larger wires. It seems that with the hand held at this distanc the wire lays itself more naturally and easily. It is well to cover each layer with a thickness of thin, stiff paper before beginning to wind the next layer. This makes the surface smoother, and renders the winding easier. The accurate winding of electro-magnets is a question of practice to a great extent. We have seen some very excellent winding done with the simple hand apparatus described above.

24. NAMES AND ADDRESSES.

What is the name and address of the person at the head of the Massachusetts Institute of Technology? What is the address of Edison, the electrician?

EAST CLARIDON, O. C.

Dr. Francis A. Walker is president of the Massachusetts Institute of Technology. A letter addressed to him at the Institute, which is in Boston, will reach him. Mr. Edison's address is No. 65 Fifth avenue, New York City.

THE TELEGRAPH.

MADE HAPPY.—The Mutual Union employés in Chicago are very much elated over the prospect of remaining in their present positions, the order dismissing them and turning them over to the Western Union having been recalled.

USE FOR ALDERMEN.—The New York *Tribune*, says: The Postal Telegraph wires are now open to the city limits of Chicago, but cannot get in for the City Council's ring. The best use for aldermen will be to string them along the telegraph wires in cities, taking care that their feet do not touch the ground.

MAKING CHARLESTON A PORT OF CALL.—The "Charleston & Morris Island Cable Co." of Charleston, S. C., is preparing to lay a cable between Charleston and James Island. When the line is completed, which will be in June, Charleston will be made a "port of call" for vessels. There will be a telegraph station at Quarantine, on James Island.

THE LATEST RUMOR.—A rumor was current on the street last week that Mr. Vanderbilt is interesting himself in telegraphy, and that two of his intimate friends are about starting a company with $20,000,000 bonds and $10,000,000 stock. The proceeds from the bonds are to be used in constructing a complete telegraph system for the United States and Canada, and the stock is to be kept in the grip of the Vanderbilt family as tightly as if in a vise. The story was probably made up for effect on the market.

PAYING THE POLE TAX.—The city council of Wilmington, Del., at its last meeting directed the city auditor to have the Western Union Telegraph Company's poles removed from the streets if the municipal tax of $1 per pole was not paid in five days. The time expired on the 15th and the auditor announced that if the tax was not paid by 9 o'clock on the morning of the 16th he would begin cutting down the poles. The telegraph company's attorney at the last minute promised to pay, under protest, the tax, which amounts to $850.

TUBES UNDER BROADWAY.—It is announced that the Western Union Telegraph Company will begin the work of laying pneumatic tubes under Broadway this week. They will also lay tubes in which telegraph wires will be carried. There will be six of these tubes, and they will extend from the new Produce Exchange building to Forty-sixth street, and through that street to Fourth avenue. At distances of 400 feet brick man-holes about four feet square will be built, so that repairs may be made without tearing up the pavement.

MUTUAL DISTRICT MESSENGER CO., OF WASHINGTON, D. C.—At a meeting of the stockholders of this company held at 46 Bond street, N. Y., May 7, it was voted to increase the number of directors from seven to nine, and the following-named gentlemen were elected directors: Wm. F. Chester, H. W. Gwinner, H. W. Pope, W. H. Woolverton, Wm. F. Allen, Chas. H. Sewall, Chas. E. Pugh, Max Reibenack, H. McGonegal, Mr. Wm. F. Chester was reelected president and Mr. H. W. Gwinner, secretary and treasurer, *vice* Mr. Geo. F. Truell, resigned. This company opened for business April 2, and has been very successful. It has at present three district offices in operation.

MUTUAL UNION OFFICES IN PENNSYLVANIA.—In reply to the inquiries of a reporter the manager of the Mutual Union Telegraph Company in Pittsburgh states that the office, which it was expected would be closed on the 1st of May, will be kept open for an indefinite period, likely a year longer at least. Other prominent offices in the State will be kept open for the same length of time. Unimportant offices are being closed as rapidly as possible. The only reason any offices are kept open is because the courts of that State have refused to sanction the lease of the Mutual Union lines to the Western Union Company, and the business of the two companies cannot be completely consolidated until this legal obstacle has been surmounted.

NEW TELEGRAPH COMPANIES IN CHICAGO.—A *Tribune* reporter called on the officials of the Western Union Telegraph Company yesterday and inquired as to the standing and backing of the District Telegraph and the Merchants' Union Telegraph companies, which attempted on Friday night to rush orders through the Council permitting them to string wires on iron poles. When the District Telegraph ordinance was introduced Ald. Wickersham hazarded an opinion that it was in the interest of the Western Union. It was learned that the incorporators of the District Telegraph Company are C. Cady Louis, who conducts a fertilizing establishment, and Louis Guiland and F. H. Roeschland, clerks. The capital stock is placed on paper at $20,000. Whatever the purpose of the incorporators may be, it has been ascertained that the Western Union is in no way identified with the scheme. Superintendent Tubbs, of the Western Union, said yesterday that the plan of stringing wires on iron poles had been tried in New York, but had been abandoned as unsatisfactory. By referring to his scrap-book he showed that the Merchants' Union Telegraph Company was incorporated Feb. 2, 1883, the incorporators being John J. Curran, Henry H. Evans, and Conrad L. Niehoff. Just what the incorporators of this concern hoped to accomplish he could not imagine.—*Chicago Tribune, May 6.*

THE TELEPHONE.

A LESSON.—A young man in Peoria, Ill., was knocked down a few days ago while using a telephone during a thunder storm.

SUICIDE OF A MANAGER.—W. S. D. Hunt, telephone manager at Litchfield, Ill., committed suicide at St. Louis on May 16. Cause, unrequited love.

TELEPHONE FACTORIES.—There are six telephone factories in the United States, all doing a prosperous business. In one alone orders have been received for 6,000 instruments in six weeks' time.

ANOTHER KIND OF PHONE.—A Cleveland architect has invented what he calls the "multiphone," for enabling persons in any room of a building to converse with persons in any other room. It consists of a system of speaking tubes running to a central switch-board, where an attendant can couple any two together, as may be desired.

DECATUR, ILL.—First-class telephone and telegraph facilities are enjoyed by Decatur. Direct communication by telephone has been established with Springfield, distant 40 miles; Bloomington, 40 miles; Lincoln, 30 miles; Hammond, 25 miles. In course of construction, Blue Mound, 22 miles; Monticello, 29 miles.

LOWER RATES WANTED.—Citizens of Elgin and Aurora, Ill., are reported to be much dissatisfied with the rentals charged for telephones in those places—$50 a year. In Aurora, it is said, a majority of the company's subscribers have organized a league, pledging themselves to have all phones removed from their places of residence and business on the 1st of June unless the annual rental shall be reduced to the uniform rate of $25 by that date.

ANOTHER PURCHASE BY THE LOWELL SYNDICATE.—The Lowell, Mass., Telephone Syndicate, on the 18th, closed the purchase of the Southwestern Bell Telegraph and Telephone Company, with a capital of $2,000,000, covering for all telephonic purposes, the entire states of Arkansas and Texas. The price paid is understood to have been $50 per share. The new territory comprises nearly 3,000 subscribers and several hundred miles of extra territorial lines. The old officers have resigned and the following have been chosen: President, W. A. Ingham; treasurer and clerk, Charles J. Glidden; general manager, Loren N. Downs; and in addition to the above these directors: A. A. Coburn and W. H. Bent. Mr. Bent is also the attorney. The headquarters of the company will be removed from Little Rock, Ark., to Austin, Texas. The syndicate making the purchase is composed of forty members, who take blocks of 500 shares each, making the total cost to each person $25,000. Twenty-five members of the syndicate are from Lowell, ten from Boston and five from Manchester, N. H. It is understood the payment is to be cash. The company is at present earning 4½ per cent. on its two million dollar capital, or 9 per cent. on the money invested in the purchase. The new managers will take possession of the property immediately, and Mr. J. P. Wheeler, now assistant manager of the eastern companies, will go to the new field, with several of his best associates as assistants, and take full charge.

TELEPHONE CONSTRUCTION.—We have reports of telephonic progress in various parts of the country last week as follows:

Pennsylvania—A new telephone line has been built between Sunbury and Shamokin. It will be extended to Mt. Carmel soon.

Vermont—A trunk telephone line to connect Rutland and the larger Vermont towns with Keene, Springfield, Hartford and other cities, is now building between Brattleboro and Keene.

Maryland—A telephone line has been erected between Lapidum and Glencove. Work has been commenced on the construction of a telephone line between Hagerstown and Smithsburg, and in a short time work on a similar line from Hagerstown to Boonsboro' will be in progress.

Illinois—The telephone line between Salem and Centralia is completed. The citizens of Salem can now converse with their friends in Centralia, Sandoval and Odin. The company intend to have a line in operation between Salem and St. Louis in a few weeks. A persistent effort is being made in Waukegan to get up a telephone exchange. The company requires that twenty-five subscribers come forward and pay $50 each per year before it will consent to establish the exchange. Over half of the the number required has been secured.

Ohio—The Midland Telephone Company has been putting up a line between Painesville and Cleveland, taking in the intervening towns. The citizens of the aristocratic village of Willoughby, thinking the tasteful appearance of their streets would be marred by the telephone poles, rose up in arms. Mounting a lumber wagon, the village officials drove upon the enemy, and planting their standard

THE ELECTRIC LIGHT.

EVANSVILLE, Ind., is putting in an Edison plant.

ARKADELPHIA, Ark., is experimenting with the electric light.

READING, PA., is to be lighted by electricity from June 1.

BY ELECTRIC LIGHT.—Lawn tennis by electric light will probably be popular this summer.

HARTFORD'S councilmen and street commissioners are willing to let the electric light company erect poles in the streets, but the aldermen flatly shut down on the project.

CINCINNATI.—The Brush Electric Light Company is ready to start up with entirely new machinery, having restored all the damage caused by the recent fire.

upon the corporation line, proclaimed to the telephone gang, "Thus far shalt thou go and no farther!" The result is that the telephone line passes about a mile north of the village, and the company declares that it will be a peculiarly frosty morning when Willoughby is blessed with a telephone.

PERSONAL.—Mr. George H. Roe, representing the Brush Electric Light and Power Company on the Pacific Coast, is visiting the East, and was in Cleveland last week.

THE BRUSH ACCUMULATOR.—The works of the Brush Electric Company, Cleveland, O., are now turning out lead electrodes for the Brush accumulator at the rate of 7,700. lbs. a day.

LIGHTING THE SEA.—A correspondent says: During the trip of the Albatross from Wilmington an arc light has been first successfully operated on an Edison circuit, and an invention has been completed for lighting the surface of the sea, which will be useful for signaling and for the prosecution of all kinds of work at night.

THE ELECTRIC LIGHT IN THE WESTERN UNION BUILDING.—The fifty incandescent lights placed in the operating room in the Western Union building, this city, have given good satisfaction, and the United States Electric Illuminating Company, whose system is used, has placed one hundred more lights in various parts of the building.

PROTECTING PEOPLE WHO BLOW OUT THE GAS.—A Baltimore genius has patented a device for use in hotels, to prevent ignorant guests from committing involuntary suicide by blowing out the gas. It is to be hoped that before many years have elapsed our hotels will be lighted by electricity, when it will not be necessary to protect the guests from the perils of the illuminating agent.

THE EDISON LIGHT IN THE HOUSE OF COMMONS.—Some of the city papers copied a paragraph from London *Truth* which declared that the Edison lamps in the library of the House of Commons went out twice within a period of ten days. Mr. Edison states, through the *Evening Post*, that the system used in the House of Commons at the time alluded to was the Swan light; and that since his lights have been in use there no failure has occurred.

THE INCANDESCENCE LAMP ABROAD.—The town of Szeged, in Hungary, (70,000 inhabitants,) has been partly lighted with incandescene lamps by Messrs. Ganz & Co. The first installation is in the street leading to the railway station, which has been furnished for a length of about 1,000 yards with incandescence lamps of about 20 candles, spread at intervals of 40 yards. In the Place at the end of the street are placed 4 arc lamps.

ELECTRIC LIGHTS FOR BROOKLYN.—The Committee on Streets of the Brooklyn Board of Aldermen, on the 17th, determined to report favorably on the petitions of the Fuller Electric Light Company and the United States Electric Light Company, recommending that each company be compelled to furnish to the city nine lights, free of charge, and one extra light for every fifty customers, after 300 have been secured.

THE SIEMENS LIGHT.—After a sharp competition Messrs. Siemens Brothers have obtained the order for the electric lighting of the Steamer Aurania, the new boat of the Cunard line. The success of the installations on the Arizona and Alaska has been so decided that the Cunard Company has decided to adopt Messrs. Siemens Brothers' system in its entirety, including the rope transmission, instead of obtaining their machinery through intermediate companies, as in the case of the Servia.

ELECTRIC LIGHTS FOR THE HARBOR.—A consultation was held in this city on Saturday last between Major D. I. Heap, of the Light-house Board at Washington, General Duncan and Professor Morton, in reference to the getting up of appliances and the making of tests for lighting light-houses by electricity. The plans for illuminating the entrance to New York harbor by an electric light tower have been completed and will be submitted to the Lighthouse Board at its next meeting.

SPARROWS NESTING IN AN ELECTRIC LAMP.—The Cleveland *Leader* says: "The English sparrows are causing an electric light employe a good deal of worriment. It is in connection with a light at the N. Y. P. & O. depot. The sparrows are determined to build a nest between the cut glass shade and the iron frame. Every day for the past three weeks they have brought a quantity of straw, hay, twigs and such like to this nook, and by bed-time these substances are shaped somewhat into the semblance of a nest. In the morning when the electric light man comes around to renew the carbon points he regularly removes and destroys the nest, which the sparrows attempt to rebuild with the same regularity when he has gone.

THE EDISON SYSTEM AT SEA.—The Electric lighting plant on board the Steamer Tarawera, of the Union Steamship Co. of New Zealand, limited, which was fitted up with the Edison system, is reported to have worked well throughout the voyage from Greenock to Melbourne. Only ten lamps (out of a total 150) gave out during the voyage. As the loss of lamps during the first few weeks after starting an installation generally averages higher than that which occurs after the plant has been in use for a short period (owing to the weeding out of defective lamps), the result stated above may be reckoned as very satisfactory.

A BOON TO MINERS.—Probably none are so indebted to electricity as the miners. Working in the bowels of the earth is dangerous business. Explosive gases abound, and the use of any kind of lamp is attended with danger. The small, incandescent light was hailed with delight by the miners. As it requires no air—air is fatal to the life of its carbon—and is hermetically sealed there is no danger in using it, even among the most explosive gases. Not long since, in Cornwall, England, the miners made quite a demonstration in appreciation of the electric light that had been furnished them by M. Mangin. In order to prove the safety of this lamp Mangin placed it in the middle of a balloon filled with hydrogen. The application consists of an incandescent lamp immersed in a glass globe containing water. It is further intensified by a copper casing with silvered interior and one or more strong lenses.

A RUMORED RESIGNATION DENIED.—We are requested to republish the following from the Reading, Pa., *Times*: "An item having been copied into the local papers from THE ELECTRICAL WORLD, published in New York, to the effect that O. W. Stager, Esq., superintendent of the P. & R. Telegraph Company, had connected himself with the Reading Electric Light Company in the capacity of electrician, and also that he would soon resign his superintendency to devote all his time to the work of electric lighting in this territory, induced a reporter of the *Times* to call on Mr. Stager yesterday, for the purpose of ascertaining how much truth there was in the report. Mr. Stager was himself perhaps the most surprised man when he saw the statement. He stated that he knew nothing whatever of the matter—which ought to set at rest the rumors which have reached the citizens of Reading by way of New York." This refers to an item in this department published in our last issue. Although we have every confidence in the correspondent who furnished it, still he may have been misled, and we gladly publish what the *Times* says with a view to correcting any possible misstatement in the premises.

MISCELLANEOUS NOTES.

ELECTRIC HORSE-CARS.—Montreal is experimenting on the use of electricity on its horse-cars.

ELECTRICITY IN THE MOUNTAINS.—The Southern Electric Company of Baltimore has been awarded the contract for furnishing the new hotel at Pen Mar Blue Mountain House with electric apparatus.

AN EVENTFUL LIFE.—From Maine comes the story of a woman only thirty years old who has been struck by lightning twice; has been on the train when it was attacked by robbers once; has been apparently drowned twice, abducted twice and met with numerous accidents with horses, and is still hale and happy.

NOT A CENT FOR CYCLONES.—General Hazen has telegraphed to the weather bureaus in the West Indies to make no more reports on cyclones. Congress having failed to make appropriations for the purpose. This is pretty rough. The motto of Congress appears to have been: "Twenty-five thousand dollars for improving Mud Creek, and not one cent for cyclones."—*Norristown Herald.*

THE UNDERGROUND COMMITTEE.—A circular letter has been issued by Mr. W. C. Behrens, secretary of the Committee on Underground Electrical Communication. The circular gives the names of the members of the committee and the names of the members of the three sub-committees. The instructions to the sub-committee on electrical and mechanical devices are also added. The circular concludes with the statement that the committee is prepared to examine all plans that may be submitted for its consideration.

EXPERIMENTING WITH ELECTRIC BOATS.—The electrical exhibition of the Franklin Institute will, if the programme is carried out, be a most important event. A building will be erected on the banks of the Schuylkill in the park, for electric boats to be experimented with. The Institute has its own building, but there is no room there for its display. Some years since it gave a notable exhibition at Broad and Market streets, in what was then an abandoned freight depot, and it was hoped at the time that its exhibition was to be annual.

THE COOK'S FUTURE FUEL.—Cooking by electricity is likely to be the next practical application of the mysterious force. A Montreal man has invented a machine for the purpose. It consists of a saucepan so isolated by non-conductors that the bottom forms the positive pole for the current. The negative pole is attached to a movable point which travels in circles over the bottom of the pan underneath, distributing the heat over the whole surface and with sufficient rapidity to avoid burning a hole through the pan at any one point.

DRIVING PILES BY ELECTRICITY.—One of the last things to which one would believe electricity could be applied is pile-driving, yet it recently proved very successful in this work. At Hatfield Park, the seat of the Marquis of Salisbury, the piles to support a coffer dam across the River Lea were recently successfully driven by the power of a water-wheel situated at a distance. The power was transmitted by two dynamo machines to the gearing connected with the pile-driver of ordinary construction erected on a barge floating in the river. The machinery worked well, lifting a monkey weighing about 400 weight with ease and regularity. It is not stated how far the power was transmitted.

WHO INVENTED THE FIRST ELECTRIC LOCOMOTIVE?—As in the case of most other important applications of electricity, the original invention of the electric locomotive promises to be a vexed question. *Iron* says: "The first electric locomotive was invented by a Swedish engineer, Herr H. Wesslau, in the employ of Messrs. Siemens & Halske, of Berlin. The document to this effect, now in the Patent Office in Washington, sets forth that the first drawing to their engine was made by Herr Wesslau in September, 1878, while Edison's was not made until November, 1879. Herr Wesslau is a native of Holland, in Sweden, and has for many years been employed in some of the best German engineering works." We noted in our issue of May 12 that Mr. Stephen D. Field claims that his calculation dates prior to 1877, and that he filed his caveat in 1879.

A NEW ELECTRIC DANGER SIGNAL.—A recent disaster on the Grand Trunk Railway has stimulated a young man of Battle Creek, Mich., to invent a danger signal, for which the claim of novelty, at least, can be justly made. It requires an extra wire to be stretched between each two stations and terminating by a ground connection. At intervals of about six poles are electric lights with a red globe. The train is provided with a storage electric battery, and a small wire connected with it. When an accident occurs on account of a hot box, broken rail, bursting hose, etc., to warn an approaching train, instead of sending a man with a lantern, the engineer would take the battery-wire and cast it over the main wire, when each of the red globes would be instantaneously illuminated and notice given to both stations. By making and breaking the connection, the conductor could signal for help.

ERRATIC ELECTRICITY.—Lightning is no respecter of persons. At Liontown, Va., the other day, during a raging storm, it played some ghastly tricks. In a negro cabin some friends were keeping watch over the dead body of a colored boy. Outside the darkness and disturbance of the storm were appalling. Within the humble house of mourning awe and terror made the scene one of fearful solemnity. The frightened negroes knelt in prayer, which was interrupted by an erratic electric bolt striking the chimney, demolishing half of it and scattering the debris in every direction. The lightning passed into the house tearing the planks above the mantelpiece and dashing them over the corpse as though they were splinters. A man and woman were knocked senseless and terror and demoralization completely overwhelmed the other inmates. As soon as the storm permitted, neighbors came to the scene of desolation, restored the injured man and woman to consciousness and removed the dead body from the burning dwelling to a place of safety.

DAFT'S ELECTRIC RAILROAD.—Greenville, a village four miles out on the New Jersey Central Railroad, is the scene of Mr. Leo Daft's experiments in running electric motors built to take the place of horses on a horse-car line running from Newark to Bloomfield, a distance of three and a half miles. Until a few months ago the Daft Electric Company devoted itself almost entirely to the manufacture of electric lamps, but electric motors are now receiving much of its attention. Mr. Daft claims that by a peculiar subdivision of his dynamo he obtains a current of low tension, which is automatically switched out and in, according to the work demanded of it. Thus the tension of the current is so low that there is no necessity for insulating the tracks at all when using them for the electric current. So long as there is no metallic connection between the two tracks, the dynamo producing the current does no work. Establish a connection through one of the motors on the track, and the dynamo becomes active, and the motor on the track leaps forward.

STOCK QUOTATIONS.—Telegraph, telephone and electric light stocks were quoted on Wednesday of last week and Tuesday of this week as follows:

	May 16.	May 22.
Western Union Telegraph	82¼	81¾
Mutual Union Telegraph	19¾	20
American Cable	67¾	67¾
Edison Illuminating Co	60	55
Edison Electric Light Co	325	315
Parker Electric Manufacturing Co	....	....
N. J. & Long Island Telephone Co	99	105
Underground Electric Cable	60	....
U. S. Electric Light	....	150
Shaw Telephone	....	....
Bay State Telephone	....	130
Edison Isolated	160	150
Commercial Telegram	110	112
Eastern Overland Telephone & T	2e	....
People's Telephone	20	19
Union Telegraph and Telephone	110	....
Granite State Telephone	92¾	....
Postal Telegraph Bonds	....	69
Brush Electric Light	....	100
Mexican Telephone	2⅛	....
Tropical Telephone	2⅞	....
American Bell Telephone	238	235
Northern Telephone	151½	153½

ELECTRICAL PATENTS ISSUED

And Dated May 15, 1883.

Apparatus for measuring and recording electric currents; John Hopkinson, Westminster Chambers, County of Middlesex, England 277,731

Bracket for electric incandescent lamps; Edward Weston, Newark, N. J. 277,641-2

Circuit-controlling device; Edward Weston, Newark, N. J. 277,640

Dynamo-electric machine; Edward Weston, Newark, N. J. 277,644

Electric-lamp fixture; Edward Weston, Newark, N. J. 277,643

Electric lamp and holder therefor; Edward Weston, Newark, N. J. 277,645-6

Electric lock; Mortimer Sullivan, Brooklyn, N. Y. 277,628

Electric gas-lighting; Thomas H. Rhodes, Brooklyn, N. Y. 277,610

Electric head-light for locomotives; Flamer Bell, Jr., Cincinnati, Ohio 277,536

Electro-magnetic engine; Gay W. Foster, New York, N. Y. 277,475

Insulating wire for electric purposes; John J. C. Smith, College Point, N. Y. 277,519

Laying underground electric wires; James Marks, Newark, N. J. 277,588

Process of manufacturing carbons for incandescent lamps; Hiram S. Maxim, Paris, France 277,846

Railway telegraphic signals; Rudolph M. Hunter, Philadelphia, Pa. 277,569

Support for electric cables; Augustus Wright, Providence, R. I. 277,528

Secondary battery; Emil Boeltcher, Leipsic, Germany. 277,445

BUSINESS NOTICES.

Mr. Maurice Brick, a well-known operator in the Western Union main office, this city, offers, through an advertisement in another column, to supply telegraphers and electricians with strictly first-class cigars at low prices. His price list will be sent free on application.

The attention of persons interested in local telegraph and telephone organizations is respectfully called to the electric lighting system of THE FULLER ELECTRICAL COMPANY, and the practicability of making arrangements with that company for the introduction of its apparatus, either in isolated plants or through the formation of local companies desiring to engage in the business of electric lighting. The specially valuable features of this company's system may be seen by examination of its apparatus in Boston, Worcester, Providence, New York City, Brooklyn, Jersey City, Paterson, Philadelphia, Hartford, Lancaster, Scranton, Syracuse, Rochester, Buffalo, Pittsburgh, Wheeling, Steubenville, Xenia, Dayton, Grand Rapids, Chicago, Springfield, Belleville, St. Louis, St. Paul, and many other smaller places throughout the country. Correspondence is invited.

THE FULLER ELECTRICAL COMPANY,
44 East 14th street, New York City.

All Persons Sending for

Catalogues or ordering articles advertised in our columns will do us and our Advertisers both a great favor by mentioning that they saw the advertisement in

The Electrical World.

100 Japanese Napkins, 20×20. Best goods By mail, $1. G. W. LAKE, 74 Pine St., N. Y.

"OPERA BOXES" Beautiful Set of **Imported Cards** by mail, on receipt of two 3c. stamps. WHITING, 50 Nassau St., New York.

A YOUNG NORWEGIAN, HAVING TECHnical knowledge of electricity and chemistry, with long practice, seeks employment. Address CHEMIST, 17401, Messrs. Rowell & Co., 10 Spruce St., New York.

THE AMERICAN JEWELRY COMPANY

send free, by mail, an elegant illustrated catalogue of the best make of gold and silver **Waltham Watches** and latest styles of **Diamond Jewelry**, with prices attached. Address **AMERICAN JEWELRY CO., No. 5 Arcade, Cincinnati, O.**

BIG OFFER To secure future trade, we will on receipt of 5—3 ct. stamps and Names and Address of 4 friends, send this elegant Tortoise shell 4 blade 4½ in. Steel Knife with Toothpick and Toilet blade, or 2 for 25 cts. and 8 Names. Address **H. LOWEY**, 85 Nassau St., N. Y.

BATTERY JARS.
ELECTRIC LIGHT GLOBES
OF ALL KINDS
MANUFACTURED BY
Empire State Flint Glass Works.
F. THILL, 104 to 112 KENT AV.,
Brooklyn, E. D., N. Y

WHEN YOU WANT
Fire Insurance,
WRITE TO
JOSEPH E. CRAWFORD,
MOUNT VERNON, N. Y.,
Representing eight Fire Insurance Companies, also the "Travelers," of Hartford, Conn.

WAKEFIELD
EARTH CLOSET.
JOS. J. WALTON,
23 & 25 Dey St., N. Y.

1,000 OPERATORS WANTED.
Increased salaries. Secure agency for latest, most attractive and fastest selling books out, "Spy of the Rebellion," 700 pages marvelous spy work during the late civil war; "Professional Thieves and Detectives," 600 pages of thrilling adventures with notorious criminals; great part devoted to Telegraphy and Operators; profusely illustrated. Both books written by Allan Pinkerton, world-renowned detective. Circulars and terms free. K. S. V. RANDOLPH, Publisher, 315 Clifton Place, Brooklyn, N. Y.

For Sale.

25 Shares Mutual District Messenger Co.,
of Boston. Par $100.
Address
N. W. LILLIE,
American House, Lowell, Mass.

THE ANSONIA
BRASS & COPPER CO.,
MANUFACTURERS OF
Pure Electric Copper Wire,
For Magnets, Telephones, Electric Lights, &c.
With H. Splitdorf's Patented Liquid Insulation, covered with Cotton or Silk.

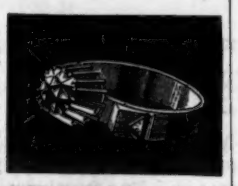
LINE WIRE.
FIREPROOF HOUSE AND OFFICE WIRE FOR IN-DOOR USE IN ELECTRIC LIGHTING. Wrought Metal Gongs, for Annunciators, Telephones, &c.
ZINC RODS, BATTERY COPPER, &c.
s. 19 and 21 Cliff St., NEW YORK.

KEUFFEL & ESSER,
127 Fulton and 42 Ann Sts., New York,
IMPORTERS & MANUFACTURERS OF
Drawing Materials.

Finest Swiss Instruments, Scales, Colors, etc., Drawing Papers, Tracing Cloth, Heliographic Blue Print Paper for copying Drawings. Drawing Tables, 12 different kinds.
Send for illustrated Catalogue.

TELEGRAPH AND TELEPHONE POLES.
65,000 25 to 60 feet, No. 1 Quality.
These Poles are Live Timber, well seasoned, and in every way desirable. Deliverable on line of F. & P. M., Mack. Div. M. C., P. O. & Pt. Austin Railroads.
Electric Light, Railroad, Telegraph and Telephone Companies supplied. Prompt delivery.
HENRY C. RIPLEY,
EAST SAGINAW, MICH.

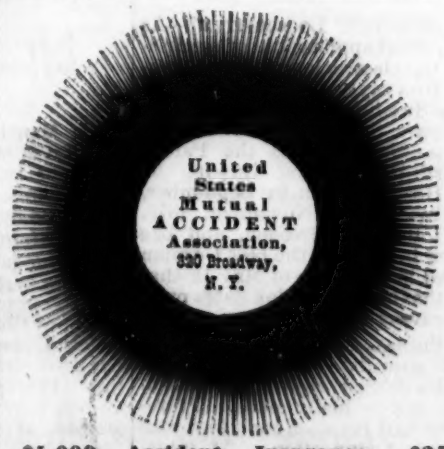
FREE GIFT.
We want 150,000 names of people living in small towns and on farms, to send our Catalogue of Novelties, useful Inventions and Publications to. We have determined to give to each person who sends us the names and address of five such people and 15 three-cent postage stamps (to pay for packing, postage and this advertisement) either of these elegant Stone Rings. They are made especially for us, and are elegant 14-karat Rolled Gold, with the best stones, Cameo and Foil Back Imitation Diamonds; they cannot be told from real gems unless examined by an expert with a file and by weight. Address
Agents' Supply Co.,
BROOKLYN, N. Y.



SUPERIOR FISHING TACKLE.

We offer a fine 3-joint Fly Rod, 15-yd. Brass Reel, 100 feet Linen Line, 3 Flies, 3 Hooks to gut and Leader, complete, by express, for $5.00; by mail, post-paid, $5.50. Sample Flies by mail, post-paid, 10c. each; per dozen, $1.00. 1 three-piece Trout Rod, 1 Float, 1 Brass Reel, 100 feet Linen Line, ½ dozen Hooks, 1 Sinker, 1 Gut Leader, all for $2.75.
Just published, the largest and most complete Catalogue of all Sporting Goods ever issued—as Lawn-Tennis, Base-Ball, Archery, Cricket, Foot-Ball, Fishing, Boating, and Gymnasium and Firemen's Goods, and all the latest novelties. 228 large pages, 2,000 illustrations, on fine tinted paper. Price, by mail, 25 cents.
PECK & SNYDER, 126 to 130 Nassau St., N.Y

PARTRICK & CARTER,
(ESTABLISHED 1867)
NO. 114 SOUTH SECOND ST.,
PHILADELPHIA, PA.,
MANUFACTURERS OF AND DEALERS IN
Telegraph Instruments, Telephone and Electric Light Supplies,
HOTEL AND HOUSE ANNUNCIATORS
BURGLAR ALARMS, CALL BELLS,
BATTERIES, OFFICE, ANNUNCIATOR, AND LINE WIRES, ETC., ETC.
SUPPLIES OF EVERY DESCRIPTION.
PRICES AS LOW AS THE LOWEST.
Send for Catalogues and Circulars.



$5,000 Accident Insurance. $25 Weekly Indemnity. Membership Fee, $4. Annual cost about $11. $10,000 Insurance, with $50 Weekly Indemnity, at Corresponding Rates. Write or call for Circular and Application Blank.
EUROPEAN PERMITS WITHOUT EXTRA CHARGE.
CHAS. B. PEET (of Rogers, Peet & Co.), **Pres.**
JAS. R. PITCHER, Secy.
320 and 322 BROADWAY, NEW YORK

MAURICE BRICK,
DEALER IN FINE CIGARS ONLY,
And Smokers' Fancy Articles.
SOLE PROPRIETOR OF
BRICK'S NEW NICKEL CIGAR.
Also the following and all other leading brands on hand:

La Rosa de Santiago.	**Conchas de Regalo.**
Le Flor de Henry Clay.	**Conchas Finas**
La Margarita.	**Reinas.**
Flor de Cuba.	**Conchittas.**

Goods sent by express or mail. Remit by P. O. order or registered letter.
Send for Price List to
MAURICE BRICK,
245 Franklin Avenue,
Brooklyn, N. Y.

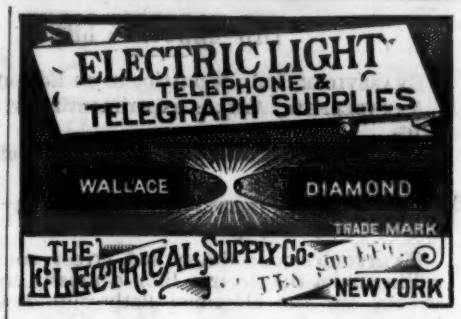
A VALUABLE PRESENT.
This Elegant Ring Given Away!
Desiring to introduce our charming Illustrated Paper, **THE HOME MAGNET**, into every home where it is not already taken, we make the following astonishing offer: On receipt of **48 cents in P. O. Stamps** we will mail you the **N. Y. HOME MAGNET for 6 Months.** We will also send you free this **Elegant Rolled Gold Wedding Ring**, which has never been sold for less than **$2.00.** This remarkable offer is made simply to introduce our paper into new homes. **We have contracted for 5,000 Rings.** Order now, as they will soon be gone. If you are not more than pleased we will refund your money. **THE HOME MAGNET** is a large Illustrated 8 page Family story Paper, filled with charming Stories, Sketches, Household Notes, Puzzles, etc.; in fact, everything to amuse and instruct the family circle. Address
HOME MAGNET PUBLISHING CO.,
7 & 9 WARREN ST., N. Y.

THE CARBONS
MANUFACTURED BY THE
American Carbon Co.,
ST. LOUIS, MO.,
Are Warranted the Best
FOR ELECTRIC LIGHTS.
L. G. TILLOTSON & CO.,
AGENTS,
5 and 7 Dey Street, N Y.

THE
LAW BATTERY

SIZE OVER ALL, 7⅛ × 4¼ INCHES.

PATENTED.
THE BEST
OPEN CIRCUIT BATTERY
in every respect, without any question.
SUPPLANTING ALL OTHERS!
With its introduction, Battery Trouble and Battery Expense become things of the past. As a
TELEPHONE BATTERY,
the LAW unquestionably excels all others. Now almost universally used by the Telephone Exchanges of the whole country.
The materials used in its construction are the very best. No acids. No odors. Great recuperative power. Nothing to renew except the zinc and sal ammoniac; no porous cup, placque or prism. Fits the standard size battery-box.
Send for Circular and Schedule of Prices.
Single Cells, $1.25.
Manufactured and for sale by the
LAW TELEGRAPH COMPANY
140 Fulton Street, New York.
WILLIAM A. CHILDS, Manager
FRANK SHAW, Engineer.



THE
ELECTRICAL WORLD,
AN ILLUSTRATED WEEKLY REVIEW
of Current Progress in Electricity and its Practical Applications.

TERMS OF SUBSCRIPTION,
Invariably in advance:
One Copy, 1 year, Postage Prepaid, $2.00.
Six Months, $1.00;
Three Months, 50c.
Clubs of 5 or more yearly subscriptions
$1.50 each.
A Copy for a year FREE to the getter-up of a club of 10 at the special $1.50 rate.

SPECIAL OFFER.
THE ELECTRICAL WORLD
will be mailed to any address in the United States or Canada from the present time until December 29, 1883,
FOR $1.00.

No one who desires to keep abreast of the wonderful activity in Electrical Discovery and Invention that characterizes our time should be without it.
The Postage to any part of the United States or the Dominion of Canada is always prepaid by the publisher, and addresses are changed as often as desired, without extra expense.
To foreign countries in the Universal Postal Union—which includes Newfoundland, England, France, Germany, Australia, etc.—the subscription price, postage prepaid, is $3.00 per annum.
Remit by post office order, draft, registered letter or express. U. S. postage stamps taken. Address communications and make orders payable to
W. J. JOHNSTON, Publisher,
No. 9 MURRAY ST., NEW YORK.

THE OPERATOR
A JOURNAL OF
Telegraphic Literature, News and Miscellaneous Reading.
PUBLISHED ON
THE 1st AND 15th OF EACH MONTH
SUBSCRIPTION, IN ADVANCE,
ONE DOLLAR A YEAR.
Postage Prepaid to any part of the United States or Canada.
To Foreign Countries the Subscription, POSTAGE PREPAID, is $1.50 a Year.

SPECIAL
"TRIAL TRIP" OFFER.
THE OPERATOR
Will be mailed to any address in the United States or Canada, postage prepaid, from the present time until
DECEMBER 15, 1883,
FOR 50 CENTS.
W. J. JOHNSTON, PUBLISHER,
9 MURRAY ST.,
NEW YORK.

WESTERN ELECTRIC COMPANY.

CHICAGO, NEW YORK.
INDIANAPOLIS,

MANUFACTURERS OF

Telegraph Instruments and Supplies, Hotel and House Annunciators, Burglar Alarms and Call Bells, Electro-Mercurial Fire Alarm, Electric Gas-Lighting Apparatus, Magneto Call Bells, Telephone Exchange Switch Boards, etc.

UNDERGROUND AND AERIAL CABLES, AND TELEPHONE APPARATUS OF EVERY DESCRIPTION

CORRESPONDENCE SOLICITED.

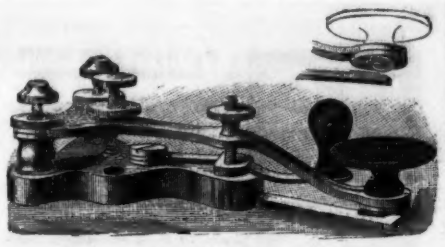
The Electrical Supply COMPANY.

The Prosch Telegraph Key

THE ONLY ABSOLUTELY

NON-STICKER

AND



(This cut is ½ size.)

EASY WORKER.

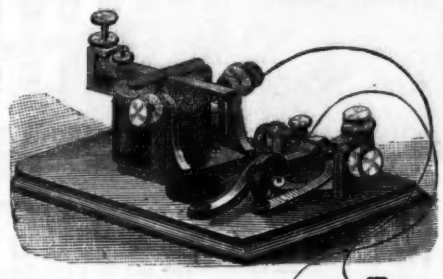
A Nickel Plated, with Platinum connections. Patented Nov. 19, 1882.

Price, - - $3.50.

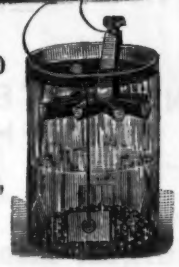
☞ Sent by registered mail.

FULL SIZE

Private Line Instrument.



No.1 Outfit Complete, $3.50



No. 1 Key and Sounder only, $2.80.

COMPLETE OUTFITS BY EXPRESS.

KEYS AND SOUNDERS BY MAIL.

SOLE AGENTS FOR

THE UNITED STATES

FOR

PROFS. AYRTON & PERRY'S

Volt Meters, Ammeters, Ohm Meters.

SOLE AGENTS FOR

THE UNITED STATES

FOR

ELLIOTT BROTHERS'

(London)

Electrical Test Instruments.

SOLE AGENTS FOR

THE UNITED STATES

FOR

FRED'K SMITH & CO.,

GALVANIZED IRON

Telegraph and Telephone Wire.

Quotations and lists on application.

The Electrical Supply Co.,

17 Dey Street,

NEW YORK.

THE

TROPICAL AMERICAN

TELEPHONE CO.

(LIMITED),

Assignee of

Professor Alexander Graham Bell, Francis Blake, Watson, Andres, Roosevelt, Fuller, et al.,

IN

Central and South America, West Indies and Mexico.

Controls the Exportation from the United States of all

BELL TELEPHONES;

BLAKE TRANSMITTERS,

And other

PATENTED TELEPHONIC APPARATUS and SUPPLIES.

All Applications for Territory or Orders for Instruments and Apparatus FOR EXPORT should be addressed to the Executive Office of the

TROPICAL AMERICAN TELEPHONE COMPANY, Limited,

No. 95 MILK ST., BOSTON, MASS.,

U. S. A.

DELANO & HAINES,

Promoters and Brokers,

TEMPLE COURT,

5 BEEKMAN ST., N. Y.

EXECUTIVE OFFICES OF THE

MEXICAN TELEPHONE CO., AND THE TROPICAL AMERICAN TELEPHONE CO., LIMITED.

These companies have acquired and own, in their respective territories, all the telephonic rights formerly the property of the Continental Telephone Co., including the *exclusive right*, for a term of years, of selling, leasing, and using Bell Telephones, Blake Transmitters, and all other telephonic apparatus manufactured by the AMERICAN BELL TELEPHONE CO., under patents owned or controlled by it in the United States and Canada.

VALUABLE TELEPHONE TERRITORY

Can be had by parties who can furnish the money requisite to develop it, in the Republic of Mexico, the West India Islands, and South America.

TELEPHONE AND ELECTRICAL

STOCKS

BOUGHT AND SOLD.

DAY'S

KERITE INSULATED

Telegraph, Telephone and Electric Light

WIRES AND CABLES,

MANUFACTURED ONLY BY THE INVENTOR,

AUSTIN GOODYEAR DAY,

OFFICE: 120 BROADWAY, NEW YORK.

FACTORY: SEYMOUR, CONN.

KERITE INSULATION should be used on electrical conductors for any of the following purposes:

Submarine, Underground or Aerial Telegraph, Telephone and Electric Light Cables; Office Cables and Lines; also for Battery, Burglar Alarm, Fire Alarm, Police and Submarine Blasting Purposes,

or for any other operation which requires perfect, indestructible and permanent insulation of electric wires.

A large number of

ANTI-INDUCTION KERITE TELEPHONE CABLES,

some of them TWO MILES IN LENGTH, are in use in several cities, and are found to WORK PERFECTLY for that distance.

Kerite is recommended and indorsed by all leading men connected with telegraphy, telephony, and electric lighting.

At the CENTENNIAL EXHIBITION at Philadelphia, Sir WILLIAM THOMSON, the eminent Electrician and Scientist, awarded to the

Kerite Insulated Wire and Cables

A DIPLOMA

For "Excellence of the Insulation and Durability of the Insulator."

For Sale by all Dealers in Telegraphic Materials.

CLARK B. HOTCHKISS, Gen. Agt.

120 Broadway, New York.

CHARLES WILLIAMS. JR.

(ESTABLISHED IN 1856),

109 Court Street, Boston, Mass.,

AUTHORIZED MANUFACTURER OF

THE AMERICAN

BELL TELEPHONE CO.

Magneto, Crank and Push Button Call Bells, Electric Bells, District Bells and Switches for Exchanges, Annunciators, etc.

Telegraph and Electrical Instruments, Batteries, Wire, Insulators, and Telephone Supplies of every Description.

TELEPHONE SERVICE

Without Induction and with Clear Articulation.

Nos. 14 and 12 Spiral Wire for long and short lines.

American Spiral Telephone Wire Co.,
43 Milk St., Boston, Mass., U. S.

J. H. LONGSTREET,

No. 9 Barclay Street,

NEW YORK,

MANUFACTURER AND DEALER IN

TELEGRAPH INSTRUMENTS,

Telephone and Telegraph Supplies

OF EVERY DESCRIPTION,

ANNUNCIATORS AND BURGLAR ALARM APPARATUS, BATTERIES AND BATTERY MATERIAL.

Telegraph Instruments for Railroad Use a Specialty.

THE LATEST IMPROVEMENT.

THE NEW KERNER STYLOGRAPHIC PEN.

Indorsed by all telegraphists who have ever used it. Over 200 Sold in the NEW YORK CITY POST-OFFICE.

$1.00 $1.00 $1.00 $1.00 $1.00 $1.00 $1.00 $1.00 $1.00

For our No. 1 Pen, EQUAL TO THE BEST. No. 2, Handsomely Engraved, $1.25. No. 3, Gold Mounted, $1.50. No. 4, Gold Point, Cover Handsomely Chased, $3.00. Sent post-paid on receipt of price.

INCLOSE TEN CENTS EXTRA FOR REGISTRATION.

Address THE KERNER STYLOGRAPHIC PEN COMPANY, 25 Bond Street, New York.

AGENTS WANTED.

PINS AND BRACKETS.

We are now prepared to furnish

Pins, Plain, at $10 per thousand.

Pins, Painted, $11 per thousand

Brackets Plain, $13 per thousand.

Brackets, Painted, $15 per thousand.

BEST QUALITY OF OAK.

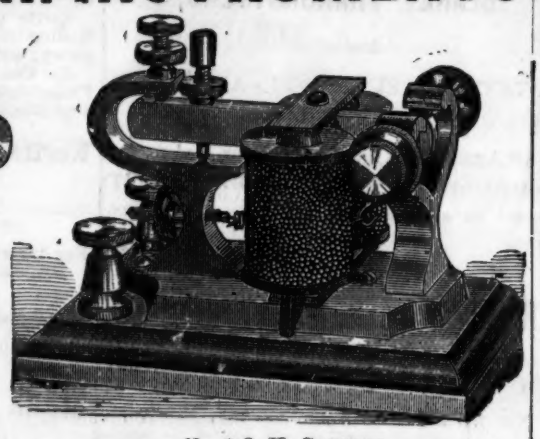
SPECIAL REDUCTION ON LARGE ORDERS.

L. B. HARRIS,
Manchester, N. H.

LYMAN'S O. K. INSTRUMENTS

NO. 2 O. K. KEY

The above Key is a perfect working key, and has *pure platinum points.* Price, $1.45, C. O. D., subject to inspection.



NO. 2 O. K. SOUNDER.

The above Sounder is warranted to work well where any sounder will. Price, $2.60, C. O. D., with privilege to examine before paying for it.

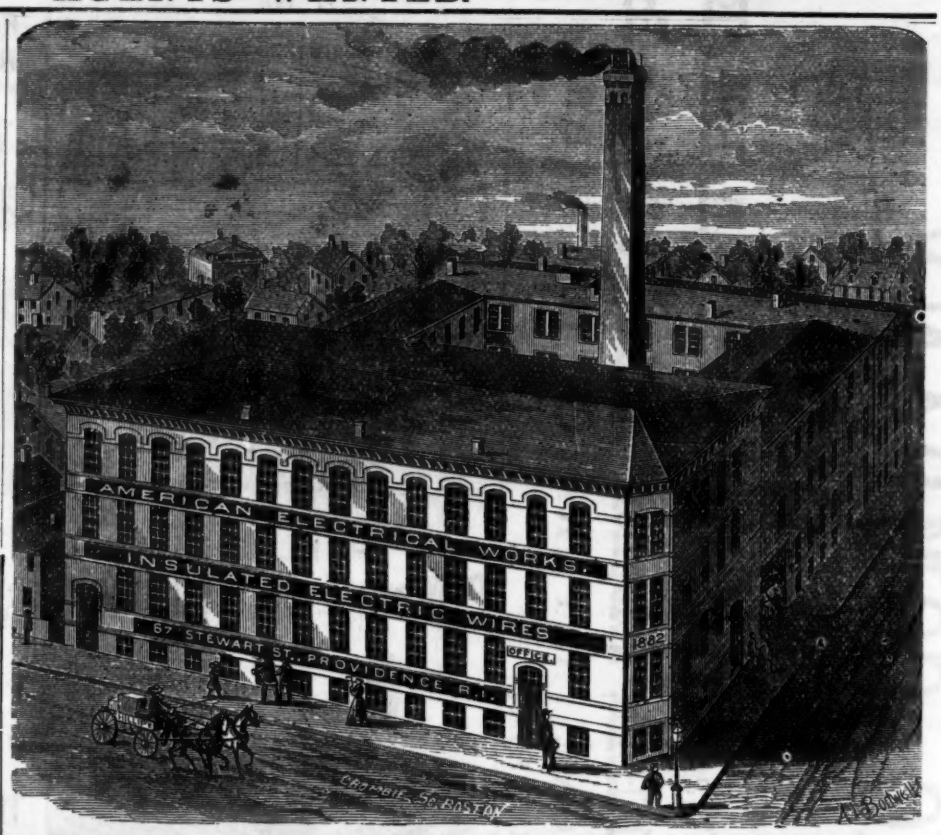
The above Sounder and Key (either on one base or separate, as ordered), one full-sized Callaud battery, 1 lb. vitriol, 15 ft. office wire, etc., all nicely packed and sent C. O. D., **$4.50,** with privilege to examine before paying for them.

These instruments are neat in appearance, strong and durable. The bases of the key and sounder are iron, japanned, and nicely ornamented with gold leaf. The levers are iron, bronzed, and look as well as brass. All the screws, check-nuts, binding-posts, etc., are of brass, nicely finished. The contact points in the key are *pure platinum.* The sounder magnets are full size, and wound to work on a line from a few feet to 10 miles without relay.

If you want cheaper instruments, send for my reduced price list, which I mail free of charge. Will fill all orders the same day I receive them. Address, mentioning THE OPERATOR,

A. B. LYMAN & CO.,

39 SOUTH WATER STREET, - - CLEVELAND, O.



AMERICAN ELECTRICAL WORKS

(Formerly EUGENE F. PHILLIPS),
MANUFACTURERS OF

PATENT FINISHED

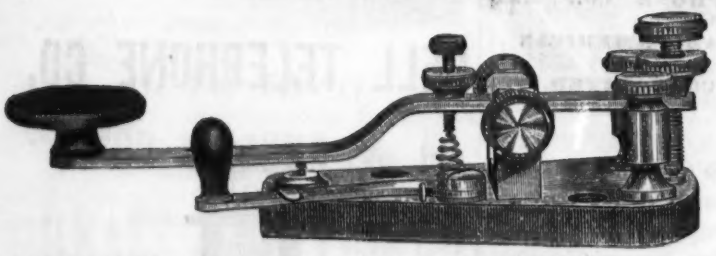
INSULATED ELECTRIC WIRES,
TELEPHONE AND ELECTRIC CORDAGE,
ELECTRIC LIGHT WIRE.

Magnet Wire, Patent Rubber-Covered Wire, Burglar Alarm and Annunciator Wire, Lead-Encased Wire; Anti-Induction Aerial and Underground Cables, etc., etc.

Office and Factory, 67 Stewart Street, Providence, R. I.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Secretary and Electrician.

THE ACME STEEL LEVER KEY IS THE FAVORITE.



Price, by Registered mail $3.

HARD RUBBER BASE, TOP CONNECTIONS, NICKEL PLATED.

PERFECTION AT LAST!

The SUCCESS of the Acme Key has been unprecedented, and it is now acknowledged the BEST and MOST PERFECT Key ever placed before the Telegraphic Profession.

Thousands are in use in all parts of the country, and we have yet to hear of the first instance where they have not given entire satisfaction. If you want the BEST and neatest Key made get the "Acme."

READ WHAT PRACTICAL TELEGRAPHERS SAY!

"Unequaled by any other key." W. H. C. Hargrave, C. L. Laverty, W. N. Gove, Joseph Christie, Joseph T. Wilde, Associated Press, Philadelphia.

"Gives perfect satisfaction, especially during fast writing, as it will not stick." H. H. Hamilton, chief operator P. & N. Y. C. R. R., Sayre, Pa.

"Best and easiest working key I ever used." Charles R. Norman, Chester Oil Co., Philadelphia

"More than pleased with it; best and neatest key I ever saw." J. F. Book, agent O. C. R. R. Luckey, O. "Well worthy of the name, and you deserve the patronage of telegraphers for supplying a great want." W. S. Burleigh, C. J. Water , B. F. Reilly, Philadelphia Stock Exchange.

"A good and perfect key " I. D. Maize, with Drexel & Co., Philadelphia.

"Neatest and prettiest key I ever handled " F. M. Saunders, T. C. & St. L. R. R., Wilshire,

"Am highly pleased with it." A. J. Scott, Pecatonica, Ill.

"It cannot be beat." J. A. McKillip, C., C., C. & I. R. R., Catawba, Ohio.

"Well adapted for fast sending and refuses to stick." C. Kammeyer, Fire Alarm Office, St. Louis, Mo.

"A first-class key in every way. We prefer it to any other key and regard it as perfect." T W. Bair, A. W. Ford, A. G. Taylor, E. B. Saylor, Perry Chamberlain, D. F. Crean, H. C. McConnell, W. M. Higbee, E. W. H. Cogley, Thomas Tibbitts, Western Union Telegraph, Phila.

The above are a few of the hundreds of testimonials received. Send for catalogues and circulars.

PARTRICK & CARTER,

Established 1867,

Manufacturers and Dealers in Telegraph, Telephone and Electrical Instruments and Supplies of Every Description.

No. 114 South Second Street, Philadelphia.

JOHNSTON'S

Electrical Agency,

FOR PROCURING

ELECTRICAL PATENTS,

AND FOR

General Expert Electrical Work.

This agency, which we have just opened, comprises two distinct departments, each of which offers electrical men and the public generally special facilities never before placed at their command.

The Patent Department

is intended as a special convenience to electrical inventors and others desirous of securing their rights to inventions of various kinds by Letters Patent, either in this country or abroad, and is prepared to attend to general patent business in all its details. It is in charge of a corps of able ELECTRICIANS and PATENT SOLICITORS, and possesses advantages for taking out electrical patents not afforded by any other agency.

Inventions examined and advice given free.

Caveats filed, specifications and drawings prepared with conscientious attention.

Applications filed and prosecuted with diligence.

Searches and reports made as to patentability, infringement, etc.

Inventors of electrical devices who wish their cases to receive skillful and scientific attention will find it to their interest to have their business done through this agency.

Terms very moderate. Prospectus sent on application.

The Technical Department

is opened to the public as a medium of general technical information on all matters relating to electrical science. Some of the most noted electricians and experts are affiliated to this agency, and we are in a position to guarantee satisfaction to all desiring to avail themselves of its superior advantages.

All persons desiring to consult with experts on electrical business of any kind will find our agency a most useful and convenient one.

Capitalists desiring expert reports on electrical inventions and systems will have their wants attended to with the assurance of getting *honest, impartial and thoroughly competent advice.*

Advice given to parties about to adopt systems of electric lighting.

Installations projected and electrical details of the same properly attended to.

Designs, working drawings and estimates for all kinds of electrical construction.

Experiments directed and carried out.

Information procured for inventors, scientists, experimenters, etc.

In short, this agency will place its experts at the disposition of the public in all matters coming within the province of the electrical engineer, and clients may always rely upon *conscientious, painstaking and thoroughly intelligent work at reasonable rates.*

For further information address

W. J. JOHNSTON,

Office of THE ELECTRICAL WORLD,

No. 9 Murray Street, New York.

PHOTOGRAPHS FOR ONE CENT EACH.

As the rage for card collecting decreases, that of Photograph Collecting increases. A great many people who have had the desire for collecting Photographs, have been deterred from so doing on account of the high price. With a view to meet the popular demand we have gotten up a line of first class [copied from life] Photographs at the astonishing low price of 1c. each. They consist of **Actors, Actresses, Statuary, Handsome Women,** etc. We have **1,500** different styles; on receipt of **25 cts.** we will send you by return mail, the following Collection of samples:

Mrs. Langtry,	Maud Branscombe,	Jennie Yeamans.	Jennie Calef	Minnie Palmer,	The Water Queen,
Sarah Bernhardt,	Jennie Cramer,	Bonfati,	Kittie Blanchard	3 Graces,	Walter Malley,
Lillian Russell,	Annie Pixley,	Miss Reed.	Mary Anderson,	Temptation,	Blanche Douglass,
Kate Claxton,	Lotta,	Lulu Mortimer,	Modjeska,	Sleeping Beauty	Henry W. Beecher.

We will not sell less than 25. We put them up in packages containing **25 for 25c. 5 Packages for $1.** P. O. Stamps taken. Bear in mind our goods are not cheap wood cuts, but genuine photographs, each one separately mounted on fine card board. **BIJOU PHOTOGRAPH CO., 9 Warren St., New York.**

PHOSPHOR-BRONZE TELEPHONE WIRE.

"Phosphor-Bronze."

The STRONGEST, TOUGHEST and BEST for line wires of electric and acoustic telephones. Will not STRETCH nor RUST. RESISTS SMOKE, ACIDS and DAMPNESS. TENACITY more than FOUR times its weight per mile.

PHOSPHOR-BRONZE RODS, SPRING METAL AND WIRE,

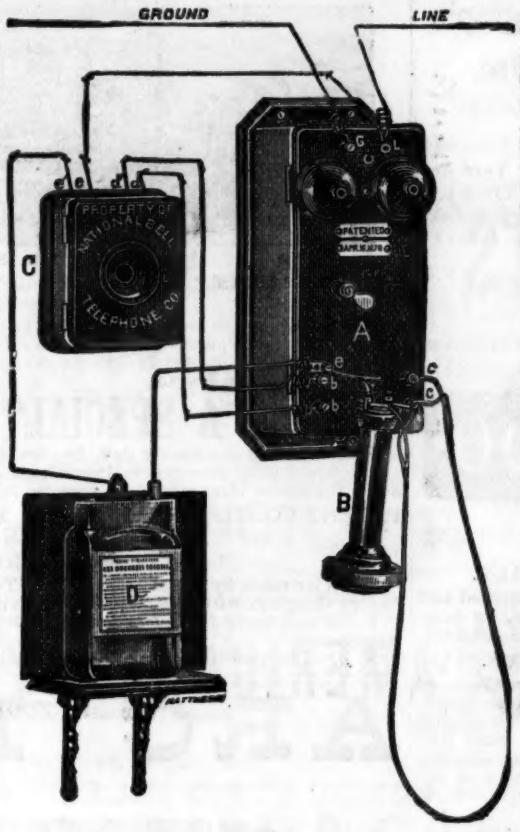
superior to German silver or brass for electrical apparatus. Already extensively used throughout the country. Address

THE PHOSPHOR-BRONZE SMELTING CO., LIMITED,
512 ARCH ST., PHILADELPHIA, PA.

Owners of the U. S. Phosphor-Bronze Patents. Sole Manufacturers of Phosphor-Bronze in the United States.

THE AMERICAN BELL TELEPHONE COMPANY.

W. H. FORBES, President. W. R. DRIVER, Treasurer. THEO. N. VAIL, General Manager.



This Company, owning the Original Patents of Alexander Graham Bell for the Electric Speaking Telephone, and other patents covering improvements upon the same, and controlling, except for certain limited territory, under an arrangement with the Western Union Telegraph Company, the Gold and Stock Telegraph Company, the American Speaking Telephone Company, and the Harmonic Telegraph Company, the patents owned by those companies, is now prepared to furnish, upon application, either directly or through any of its agents, Telephones of different styles, and applicable to a variety of uses.

This company desires to arrange with persons of responsibility for establishing

District or Exchange Systems,

in all unoccupied territory, similar to those now in operation in all the principal cities in this country.

Responsible and energetic persons are required to act as licensees for the purpose of establishing

PRIVATE LINE AND CLUB LINE

systems, for business or social uses. Also to introduce the telephone for

SPEAKING TUBE

purposes, for which instruments will be leased for a term of years at a nominal rental.

This Company will arrange for telephone lines between cities and towns where Exchange systems already exist, in order to afford facilities for personal communication between subscribers or customers of such systems.

We respectfully invite attention to this matter, and any further information relating thereto can be obtained from the Company,

No. 95 Milk Street, Boston, Mass.

All persons using Telephones not licensed by this Company are hereby respectfully notified that they are liable to prosecution, and for damages for infringement, and will be prosecuted accordingly to the full extent of the law.

GEO. H. WHIPPLE,

58 Exchange Place, N. Y.

ELECTRIC LIGHT
TELEPHONE,
TELEGRAPH

—AND—

Miscellaneous Stocks.

COMPLETE SETS OF

MACHINERY

FOR THE MANUFACTURE OF

Telegraph Cables.

Wire Stranding Machines.

Complete sets of machinery for Purifying India Rubber and Gutta Percha, and Insulating Wire.

Lapping Machines for covering Wire with Silk, Cotton, Flax, Hemp, Tape, etc.

Thomas Barraclough & Co., Limited,

8 KING STREET,

Manchester, - - - England.

W. T. HENLEY'S TELEGRAPH WORKS COMPANY

(LIMITED),

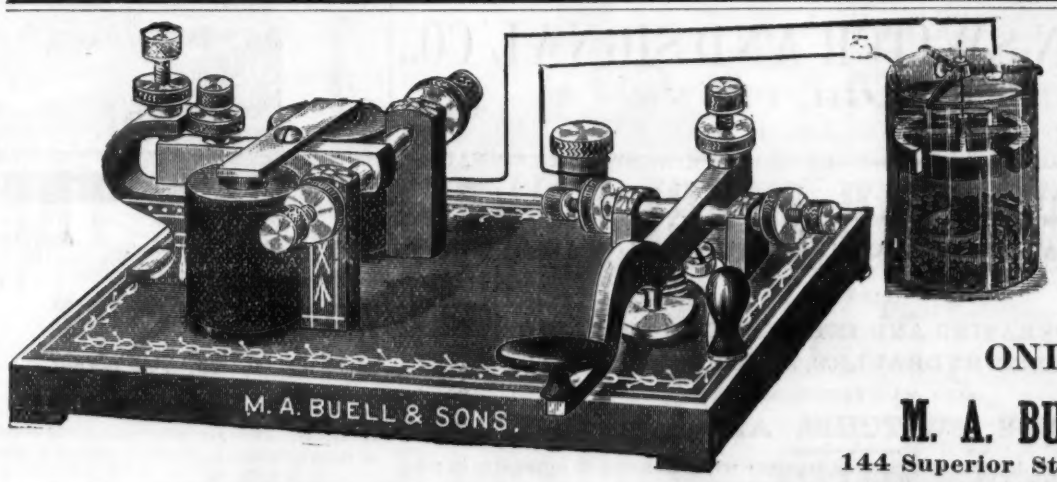
Telegraph Engineers and Contractors
Wire Drawers and Galvanizers.

MANUFACTURERS OF

Submarine, Subterranean and Aerial Cables of every description, for Telegraph, Telephone and Electric Light Purposes.

Henley's Patent Ozokerited Core,
Henley's Patent Dynamo Machines
and Electric Lamps.

Estimates for any kind of cables or core furnished. OFFICE:
8 Draper's Gardens, Throgmorton Street,
LONDON, ENGLAND.
WORKS: North Woolwich.
AGENTS IN THE UNITED STATES,
Western Electric Co. New York, Chicago.



THE STAR INSTRUMENT

Guaranteed to be Perfect and Good for 5 miles or less.

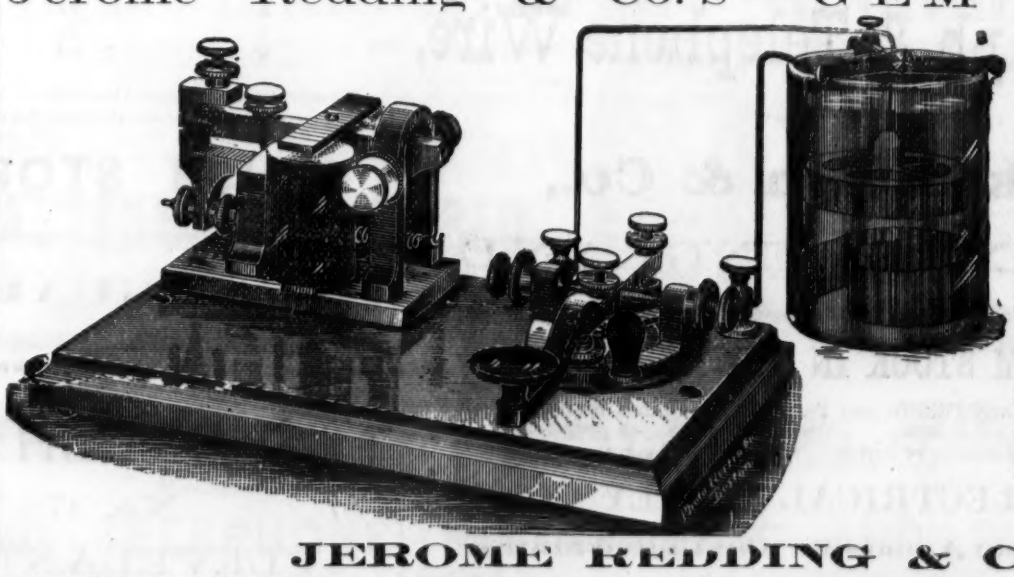
Instrument, without battery, wound with fine wire	$3.25
The Instrument, by mail	3.50
" " " wound with fine wire	3.75
Outfit, including wire, vitriol, etc.	3.50
Outfit, wound with fine wire	3.75
Instrument, without battery	3.00

ONLY $3.50.

M. A. BUELL & SONS,

144 Superior Street, Cleveland, Ohio.

Jerome Redding & Co.'s "GEM" Instrument.



$3.75.

Including the above large-sized Sounder and Key, a large Cell of Cadmium Battery, one roll of Office Wire, Chemicals, etc.

The only low-priced Instrument of this class that has nicely finished **BRASS** *Sounder and Key Lever, with perfect adjustments for both.*

Price for Complete Outfit as above	$3.75
Price for Instrument alone	3.00
Price for the whole outfit (except Glass Jar), with Key and Sounder separate, by mail, post-paid	4.32
Price for Instrument alone, by mail, post-paid	3.60
Price for Instrument alone, for lines 1 to 15 miles	3.60
Price for Instrument alone, for lines 1 to 15 miles, by mail, post-paid	4.05

SEND FOR CIRCULAR.

JEROME REDDING & CO.,

MANUFACTURERS OF TELEGRAPH AND ELECTRICAL SUPPLIES

NO. 30 HANOVER STREET, BOSTON, MASS.

HOLMES, BOOTH & HAYDENS,

MANUFACTURERS OF

FIREPROOF INSULATED ELECTRIC LIGHT WIRE

From Pure Lake Superior Copper. Conductivity Guaranteed.

Patent "K. K." Insulated Copper and Iron Wire. for Telephone and Telegraph Use.

49 CHAMBERS ST., N. Y. WORKS: WATERBURY, CONN. 18 FEDERAL ST., BOSTON.

THE TIME TELEGRAPH COMPANY

IS PREPARED TO FURNISH

Railways, Business Blocks, Public Buildings and offices generally

WITH

UNIFORM STANDARD TIME

At a low monthly rental according to the location, style of Indicator, &c.

Address, **THE TIME TELEGRAPH COMPANY,**

TEMPLE COURT, 5 and 7 BEEKMAN ST., N. Y.

Yellow Cedar Telegraph Poles,

Railroad Ties, Paving Timber and Fence Posts for Telegraph, Electric Light, Telephone and Railroad Companies' Use.

The Michael Bay Lumber Co. (Limited) have on hand and cut to order Yellow Cedar Telegraph Poles, which will last from eight to ten years longer than white cedar or chestnut. Yard and office at Buffalo, Black Rock, N. Y. Standard poles, 25 feet, 6 inch top; 30 feet, 6 and 7 inch top, and long poles from 35 to 60 feet in car load lots from Black Rock, and by vessel loads at Lake Erie and Lake Michigan ports on the opening of navigation. Fifty thousand ready to deliver April and May. Correspondence solicited. All orders addressed to

A. A. COLBY, AGENT, BUFFALO, N. Y.,

Post Office Box 207 Will receive prompt attention.

0000 HOOLE MANUFACTURING CO. 0000

46 Bond St., New York.

HENRY W. GWINNER, President. WM. H. WOOLVERTON, Treasurer.

This Company is prepared to furnish, at short notice, full lines of LIGHT RAILROAD AND FACTORY SUPPLIES. Communications and orders will receive prompt attention.

CHECKS.

BAGGAGE CHECKS, HOTEL CHECKS, RESTAURANT CHECKS, LAUNDRY CHECKS, BARBERS' CHECKS, POOL CHECKS.

BADGES.

Cap Badges, Breast Badges, Medals and Badges for Societies. Special designs furnished.

CONDUCTORS' PUNCHES.

BRASS TAGS.

Consecutively numbered and punched at end, or both ends, for use of Laundries.

UNIFORMS.

For Employés. Caps of every form, Canvas Caps, Cloth Caps, Sailor and Yachting Caps, Hats, Helmets, Sailor Suits, Jerseys, Buttons, with name of organization, monogram, or special designs.

HAND STAMPS.

GEORGE WESTINGHOUSE, Jr., President. ROBERT PITCAIRN, Treasurer.
C. H. JACKSON, Vice President and General Manager. ASAPH T. ROWAND, Secretary.
HENRY SNYDER, General Agent.

THE UNION SWITCH AND SIGNAL CO.,

PITTSBURGH, PENNA..

A CONSOLIDATION OF

THE UNION ELECTRIC SIGNAL CO., AND OF THE INTERLOCKING SWITCH & SIGNAL CO.

Of Boston, Mass. Of Harrisburg, Pa.

SOLE OWNERS AND MANUFACTURERS OF THE ONLY PRACTICALLY SUCCESSFUL SYSTEM OF

OPERATING RAILROAD SIGNALS AUTOMATICALLY.

ALSO OF

APPARATUS FOR OPERATING AND INTERLOCKING SWITCHES, SIGNALS AND GATES BY LEVERS, HYDRAULICS, PNEUMATICS OR ELECTRICITY.

ALSO MANUFACTURERS OF

FROGS, CROSSINGS, SWITCHES AND SWITCH STANDS.

☞ Plans, estimates and detailed descriptions, together with references to apparatus in practical operation, will be furnished upon application.

Office and Works, Corner Fayette Street, Garrison Alley and Duquesne Way.

Iron Telegraph & Telephone Wire,

MANUFACTURED BY

Fred'k Smith & Co.,

HALIFAX, - ENGLAND.

Wire Delivered on Board in Liverpool for Shipment to any Part of the World,

OR FROM STOCK IN NEW YORK,

Or in Bond, or Duty Paid in any Part of the United States.

Full particulars, quotations in sterling or currency, and tables and samples on application.

THE ELECTRICAL SUPPLY CO.,

Sole Agents for the United States,

17 Dey St., N. Y.

30 DAYS TRIAL. LITTLE GIANT FRENCH BATTERY.

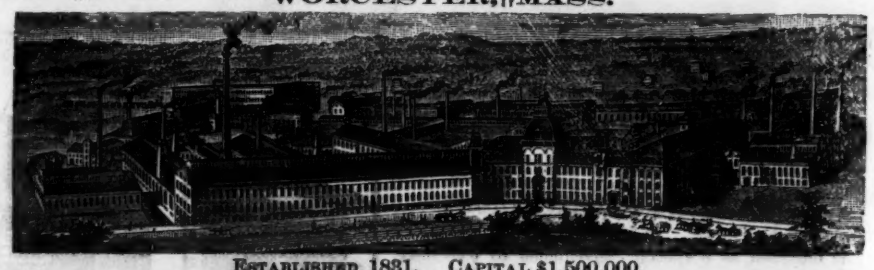
Endorsed by the most eminent Physicians for the cure of Rheumatism, Neuralgia, and all Nervous Diseases and Weakness. Every Family should have one. A. B. Cameron, of Piedmont, Wy., says: "I have successfully managed to remove Rheumatism from my left knee to my left shoulder, and from my shoulder it is now gone to parts unknown to me, with the use of your 'Little Giant' Battery." Sent by express subject to inspection. Price complete, $6.00. Send for Circular.

AGENTS WANTED. C. E. Jones & Bro., Electricians, Cincinnati, Ohio.

TELEGRAPH WIRE. TELEPHONE WIRE.

WASHBURN & MOEN MANUFACTURING COMPANY.

WORCESTER, MASS.



ESTABLISHED 1831. CAPITAL $1,500,000.

16 Cliff and 241 Pearl Street, New York.
215 Lake Street, Chicago.

This Company having given careful attention to Telegraph Wire from the introduction of the Art of Telegraphy, and especially with reference to the conditions necessary to *highest electric conductivity*, does not hesitate to recommend this class of its products as unequaled in that particular. Being the first to

MAKE A SPECIALTY OF TELEGRAPH WIRE,

and anticipating at an early day the great demand that would exist for that article, they have adopted and fully proved certain methods and appliances for the production of Telegraph as well as of Telephone Wire which are peculiar to themselves. Among them may be mentioned the

PATENT CONTINUOUS ROLLING MILL, PATENT CONTINUOUS GALVANIZING BATH, AND THE BELGIAN ROLLING MILL.

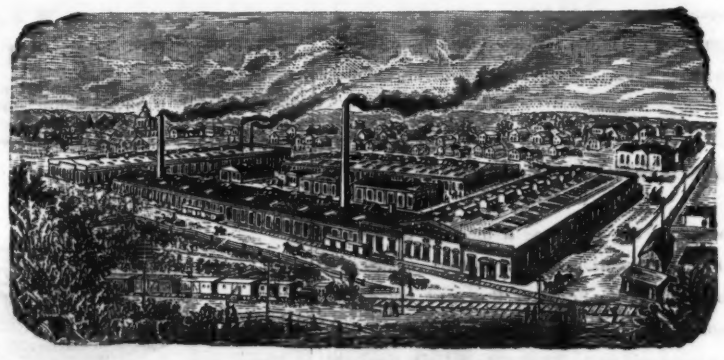
(In connection with the DOUBLE SIEMENS FURNACE).

All Wire made by this Company for Telegraph or Telephone purposes is thoroughly tested before shipping, with regard to Conductivity, Tensile and Torsion strength, as well as Elongation.

Prices and terms for Telegraph or Telephone Wire—Plain, Oiled or Galvanized—given upon application.

N. B.—The qualities known as extra Best (E. B. B.) and Best Best (B. B.) kept constantly in stock.

ARC LIGHTS.



WE DESIRE TO CALL ATTENTION TO THE

BRUSH MACHINES

We are now manufacturing, intended to give lights of about two-thirds of the power of our usual size of arc lights. They are fully equal to the ordinary size lights of other systems, and except in the amount of light are the same in every respect as our other lights.

Number of Machine.	Number of Arc Lights.	Normal Candle Power.	Horse-Power required.
5	10	1,200	6
6	20	1,200	11
7	30	1,200	15
8	64	1,200	35

Prices of our machines and lamps the same as our regular list. Our agents will give you estimates We shall commence this month the shipment of

BRUSH STORAGE BATTERIES

To fill the large orders which have accumulated on our books. We desire to state that these batteries are

GUARANTEED

By this Company, just as all the apparatus hitherto sold by us has been; and that the statements of our opponents regarding them, which have been so industriously circulated of late, are false in every particular.

THE BRUSH ELECTRIC CO.,

No. 379 Euclid Avenue,

CLEVELAND • • OHIO.

MAY 12, 1883.

WHITE CEDAR TELEGRAPH and TELEPHONE POLES AND CROSS ARMS.

We are prepared to furnish White Cedar Poles and Pine and Spruce Cross Arms, all lengths and sizes, and in any quantity, delivered on cars or at any point in New England at short notice.

Contracts taken for the building and equipping of telegraph and telephone lines anywhere in New England.

Correspondence solicited.

BARNES & SNOW,

P. O. Box 493. BANGOR, ME

Gelatinized Fibre.

(Trade Mark.)

The New Substitute for Hard Rubber.

Adopted by the leading Electric Light Companies and Manufacturers of Electrical Apparatus, being a better non-conductor, lighter and more durable, at half the cost.

Send for samples, circulars and prices to

COURTENAY & TRULL,

No. 15 Dey St., New York.

Just Published!

ELECTRIC ILLUMINATION

Quarto, 906 Pages, 833 Illustrations.

Cloth. Price $7.50.

Address,

W. J. JOHNSTON, Publisher,

No. 9 Murray St., New York.

ENGLISH

Patent Office.

H. GARDNER,

166 Fleet St., London.

Successor to

Messrs. Robertson, Brooman & Co.

Gives prompt personal attention, and obtains Patents for Inventions, Protection for Trade Marks, etc., at fixed and moderate charges. Pamphlet of costs gratis.

Thirty years' practical experience.

Provisional Protection, £8

BOSTON AND SANDWICH

GLASS CO.

OFFICE AND SAMPLE ROOMS,

No. 17 MURRAY ST., N. Y.

REPRESENTED BY

C. E. L. BRINKERHOFF.

Telegraph and Telephone Poles

(Cedar, Spruce or Chestnut).

PINS AND BRACKETS

(Painted or Plain).

Construction of Tel. Lines.

GEO. Q. DOW, North Epping, N. H.

CEDAR TELEGRAPH POLES.

LIGHT POLES FOR TELEPHONE LINES AND LONG POLES FOR CITY USE CONSTANTLY ON HAND.

50,000 Split Cedar Posts on Hand Ready for Immediate Delivery.

BROWNLEE & CO.,

Detroit, Mich.

IN WRITING TO ADVERTISERS,

Always mention that you saw their advertisements in

THE ELECTRICAL WORLD.

CHESTER & CO.,

22 New Church St., N. Y.

Formerly C. T. & J. N. Chester, 104 Centre St.

Consulting Engineers and Electricians.

Special attention given to developing inventions and securing patents. Expert advice given; every class of electro mechanical construction attended to, and all classes of electric supplies furnished. P. O. Box 2766.

LECLANCHE BATTERY.

(PATENTED)

PRISM BATTERY, COMPLETE.
Size of Jar 6 × 4¼ inches.

GREAT TELEPHONE BATTERY.

The Realization of

SIMPLICITY AND EFFICIENCY

In Electric Open Circuit Batteries.

Free from acid. Emits no odor. Does not get out of order. Lasts without renewal from six months to several years, according to use.

ADOPTED AND USED BY THE

American Bell Telephone Company.

Metropolitan Telephone and Telegraph Company.

Western Union Telegraph Company.

Gold and Stock Telegraph Company, with their battery telephones.

And by all the Telephone Companies and Exchanges in the United States.

The attention of the public is called to the new form of Leclanché Battery, in which the porous cell is dispensed with and for it substituted a pair of compressed Placques or Prisms, which are simply strapped to the Carbon (as shown in cut). The Prism Battery is more easily and cheaply cleaned and renewed than any other battery. Beware of **Infringements and Worthless Imitations.**

Every genuine Leclanche Battery has the words Pile-Leclanche stamped on the carbon head, jar and prisms. All others are spurious.

"Prisms" and Porous Cell Batteries for sale in any quantity. Zinc and Sal Ammoniac of superior quality.

The Leclanche Battery Co.

149 West 18th St., New York.

L. G. TILLOTSON & CO., Sole Agents

Nos. 5 & 7 DEY STREET, N. Y.

The Works of the JNO. A. ROEBLING SONS CO., at Trenton, N. J., have facilities for producing large quantities Telegraph Wire on short notice. The Belgian system of rolling long lengths wire rods, and improved methods of galvanizing, were first introduced in the United States at these works. It insures the production of wire with few joints and with a thick coating of zinc.

JOHN A. ROEBLING SONS CO.

MANUFACTURERS OF

TELEPHONE AND TELEGRAPH WIRE

WORKS AT TRENTON, N.J.

ALL KINDS WITH THE HIGHEST ELECTRICAL CONDUCTIVITY

OFFICE & WAREHOUSE 117 & 119 LIBERTY ST NEW YORK.

RAMSDEN, CAMM & Co

BRIGHOUSE

YORKSHIRE

MANUFACTURERS OF PATENT

Telegraph Wire

To Government Specifications.

BEST REFINED

Telephone Wire,

FENCING WIRE,

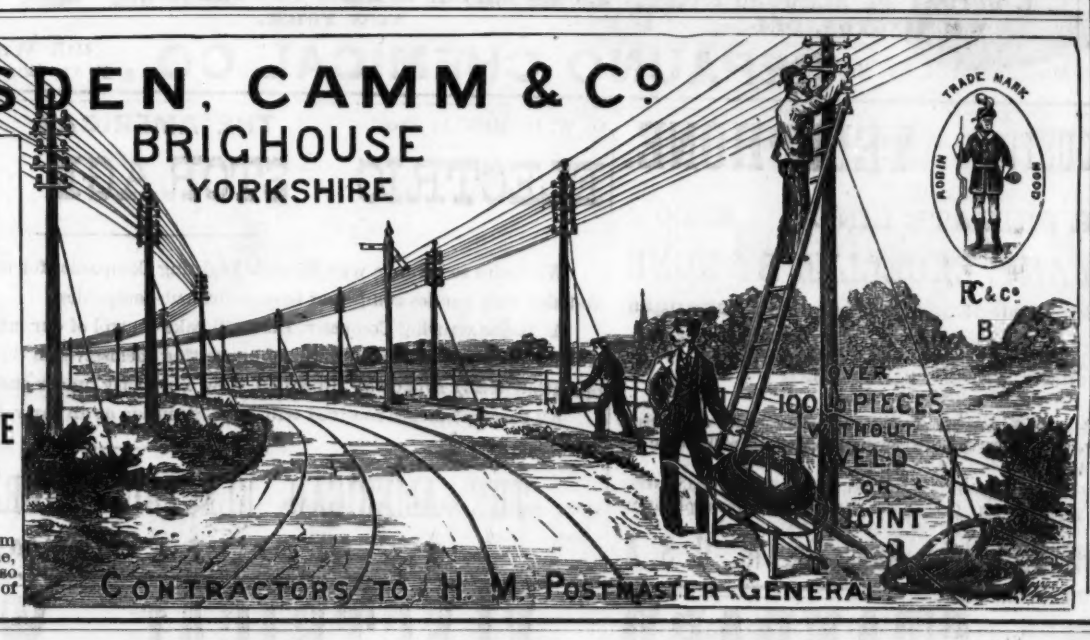
SUBMARINE CABLE WIRE

Strand & Stay Wire,

AND

Galvanized Binding Wire.

Correspondence solicited from American Telegraph, Telephone, Railway and other companies, also contractors, etc., using quantities of wire.



MAGNETO AND BATTERY SIGNAL BELLS.

We have a large number of second-hand Magneto Bells, without the Telephone switch or connections, for sale at extremely low prices.

These bells are admirably *adapted for Stable, Hotel, Restaurant* and many other purposes where a call bell of any sort would be of service for signaling or summoning all kinds of employés, servants, etc.

They will ring on any length of line and give a clear and distinct sound. THE GREAT ADVANTAGE in using such an instrument is, *YOU CAN SIGNAL BACK.*

NO BATTERY IS REQUIRED.

No Skill Necessary to Set up or Operate Them, and Always Reliable.

PRICE, $4 EACH. DISCOUNT ON LARGE LOTS.

We have a lot of these very handsome altered Telephone Bells, and will sell them at less than cost of manufacture.

They are wound to 30 ohms resistance; silk-covered wire nickel-plated bell, 3½ inches diameter, and working parts covered with nickel-plate case.

Price, vibratory..... $1.75 each.

" single stroke..... 1.60 "

WORTH TWO ORDINARY BOX BELLS AT TWICE THE PRICE.

DAVIS & WATTS, Baltimore, Md.,

Manufacturers and Dealers in all kinds of

ELECTRICAL AND TELEPHONE INSTRUMENTS AND SUPPLIES,

QUOTATIONS PROMPTLY AND CHEERFULLY FURNISHED.

TELEPHONES! ...private lines. Latest, best; always reliable; work 2 miles on cance-wire. Illus. Circulars free. Holcomb & Co., Cleveland, O.

SHORT-HAND WRITING THOROUGHLY taught by mail. Terms low; satisfaction guaranteed. Send stamp for circular and specimen of writing.
W. W. BULTON, Stenographer, Pittsburgh, Pa.

CUT THIIS OUT. WONDERFUL OFFER.
1 Pocket Book, 100 Autograph selections, 15 pleasant games, 1 package comic cards, 5 photos. of actresses, 1 nice little book containing 14 comic pictures, 12 funny scenes, 10 samples that will bring you in more money in one week than anything else you ever done. All the above will be sent free by mail for 10 cents, silver, 3 lots for 25c. MAGNET PUBLISHING CO., 7 Warren street, N. Y.

WANTED!

Situation as inspector or superintendent of electrical work, by a young man of several years practical experience. Owner of some valuable electrical patents. Address "ELECTRICIAN," care of THE ELECTRICAL WORLD, No. 9 Murray Street, New York.

ESTABLISHED 1859.

PLATINUM.

H. M. RAYNOR,
25 BOND STREET, New York.

THE BUTLER HARD RUBBER CO.

Electrical Supplies,

33 Mercer St., New York.
Manufacturers of
Sheet Rubber, Rods, Tubing, Etc.,
RUBBER HOOK INSULATORS.
Key Knobs, Switch Handles,
Magnet Covers, Magnet Heads,
Window Tubes, with Heads,
Battery Cells, Battery Syringes,
And Specialties of any Required Character.

BOOKS.

Descriptive Catalogue of Books relating to practical science—90 pages—and Catalogue of Electrical Books—12 pages—sent free by mail on application.
E. & F. N. SPON, 35 Murray St., N. Y.

LADIES'
FANCY WORK.
Do your own Stamping for Embroidery with our Stamping Patterns for Kensington, Arasene, Outline, Braid work, etc. Easily transferred to any fabric or material, and can be used over a thousand times. **Ten** full sized Patterns of Flowers, Corners, Borders, Outline Figures (see cut), Initial Letters, etc., with powder, pad and directions for stamping and working, all for **60** cents, postp'd. **15** Patterns, powder and pad, with ten reels of Embroidery Silk extra, $1.00 Outfit for dealers $5.00 to $20.00. Increase your income by selling these Patterns.
Our **Book of 150 Artistic Designs** for Kensington Needle-work, such as Sprays and Bunches of Roses, Pansies, Ferns, Apple Blossoms, etc., and Border Designs of Flowers and Vines, for Embrodering Dresses and other garments. Corners, Borders and Centres for Piano Covers, Table Covers or Scarfs, Tidies, etc., all for **25** cts, postpaid.
Our book, **MANUAL OF NEEDLE-WORK**, teaches how to do all kinds of **Embroidery**, Knitting, Crocheting, Lace-making, Rug-making, etc. **35**c. 4 for **$1.00**. Address **PATTEN PUB. CO., 47 Barclay St., New York.**

THE BEST TREE TRIMMER.

Adopted by the Western Union Co. and indorsed by all who use them.
Order one from your nearest hardware dealer, or from
Patterson Bros., 27 Park Row, N. Y.
L. G. Tillotson & Co., New York.
J. H. Bunnell & Co., New York.
Partrick & Carter, Philadelphia.
Standard Electrical Works, Cincinnati.
Circulars and description furnished on application.
E. S. LEE & CO.,
160 West Main St., Rochester, N. Y.

Short-Hand Writing thoroughly taught by mail. Good situations procured all pupils when thoroughly competent. First-class stenographers furnished railroad officials without charge for my services. Correspondence solicited. Caligraphs sold. Special inducements offered operators and railroad officers. Send for COLLEGE REPORTER and caligraph circulars to W. G. CHAFFEE, Oswego, N. Y.

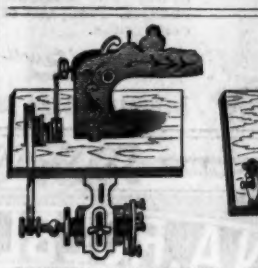
CORNELL UNIVERSITY

COURSES IN
Electrical Engineering,
Mechanical Engineering,
Civil Engineering
and Architecture
Entrance Examinations Begin at 9 A. M., June 18 and Sept. 18, 1883.
For the UNIVERSITY REGISTER, containing full statements regarding requirements for admission, courses of study, degrees, honors, expenses, free scholarships, etc., and for special information, apply to THE PRESIDENT of CORNELL UNIVERSITY, Ithaca, N. Y.

SHORTHAND AT YOUR HOMES.
COMPLETE INSTRUCTION in highest grade $20, and satisfaction assured in every respect. Send 10 cts. for specimens and terms.
R. B. CLARKE, Stenographer,
4637 Germantown Ave., Philadelphia, Pa.

FREE. **If you will cut out this** advertisement and send it to us we will mail to your address, **free**, our elegant illustrations of **18 K. Rolled Gold Solid Jewelry**, embracing **Rings, Lockets, Pins, Studs, Earrings, etc.**, of rich designs and **standard quality**, which we are now offering at the marvelously low special prices of **only one dollar each** in order to introduce our goods and catalogues everywhere. **Don't miss this extraordinary opportunity.** Address **Garside & Co.**, Manufacturing Jewelers, 239 Broadway, New York.

HAINES BROS.,
Promoters and Brokers
55 BROADWAY, N. Y.
Electrical Stocks a Specialty.



SEWING-MACHINE ATTACHMENT.

THE Double Induction ELECTRIC MOTOR
For FAMILY sewing-machines; dental, jewelers' and watchmakers' lathes, fans, etc., etc. Motor, with automatic battery and complete outfit for FAMILY sewing-machines, $35.00 to $40.00.
Double Induction Motors, Dynamo Machines, Automatic Batteries, Experimental Apparatus, etc. In writing for illustrated catalogue, give street and number.
THE ELECTRO DYNAMIC CO.,
1 9 E. 15th St., New York. 121 South Third St., Philadelphia.

THE AUTOMATIC BATTERY

Cannon St., London, Eng.

ATLAS POWDER.

(A NITRO-GLYCERINE COMPOUND.)
The strongest and most reliable of the many compounds generally termed high explosives, and conceded by every one of experience to be the *safest* to handle and transport under all conditions.
Put up in cartridges of nine different grades, and of various diameters and lengths, and packed in boxes holding 50 pounds and 25 pounds.
For sale in all sections of the country by the authorized Agents of
E. I. DUPONT DE NEMOURS & CO, WILMINGTON, DEL.
LAFLIN & RAND POWDER CO., NEW YORK.
HAZARD POWDER CO, NEW YORK.
Manufactured by the REPAUNO CHEMICAL CO., 305 Walnut Street, Room G, P. O. Box 2,472, PHILADELPHIA.

THE "ELGIN" (ACOUSTIC) TELEPHONE.

$5.00. FOR PRIVATE LINES. $5.00.
COPIED BY MANY, EXCELLED BY NONE.
The only Mechanical Telephone Adapted to Exchanges.
MADE WHOLLY OF METAL, NICKEL PLATED. WILL STAND ANY CLIMATE. SELF ADJUSTING. THE ONLY MECHANICAL TELEPHONE WHICH FULLY "FILLS THE BILL."
Parties who have exercised all their patience and who have become completely discouraged with their ill success with other Acoustic Telephones, will find in the "ELGIN" a "boon."
LARGE AMPLIFYING TELEPHONES (patented), using STEEL GALVANIZED WIRE for long lines, only $8.00 per set. Descriptive Circulars sent on application.
ELGIN TELEPHONE CO., Elgin, Kane Co., Ill., U. S. A.

G. W. HUBBELL, Pres. THE AMERICAN F. T. FEAREY, Sec. and Treas
ELECTRIC STORAGE COMPANY

We desire to arrange with Electric Lighting Companies for the introduction of our batteries, and also with parties competent to organize sub-companies.
A Manufacturing Company, that will take control of our inventions and supply our licensees, is being formed. Parties desirous of interesting themselves in this valuable invention can see it in operation at 287 Broadway, Room 40, New York City, under charge of Prof. N. S. Keith.
All correspondence received will have attention at an early day.
THE AMERICAN ELECTRIC STORAGE COMPANY,
792 BROAD ST., NEWARK, N. J.

THE FAURE ACCUMULATORS
OR
ELECTRIC STORAGE BATTERIES.
The heretofore missing link in Electric Lighting. No machinery of any kind required on or near the premises.
The light produced from these batteries is always ABSOLUTELY STEADY and pure and free from the FLICKER or PULSATION that is apparent in every light coming direct from a dynamo.
The consumer is *free from the uncertainty of steam power*, and the liability of all kinds of machinery to *stop* at the most inopportune moment. These batteries enable a *vast saving of money*, both in introducing and in after use, besides affording *heretofore* unknown comfort in the use of electricity.
They are Applicable for Power as well as Light.
For the privilege to *organize companies* under this patent, or for the purpose of *isolated* plants in any of the following States:
Virginia, North Carolina, South Carolina, Alabama, Georgia, Florida, Texas, Louisiana, Mississippi,
Application may be made to
DAVIS & PROAL,
BALTIMORE, Md.,
Rooms 29 and 31, Chamber of Commerce Building,
who are the managers for the Parent Company in the above named States, and who are prepared in its name to *issue licenses*.
They will be pleased to give any information regarding the system.
The batteries are in practical use in the Chamber of Commerce Building, and in our offices, where the entire working of the system can be seen and explained.
All communications will have immediate attention.
AUGUSTUS G. DAVIS, A. B. PROAL.

STANDARD ELECTRICAL WORKS.

LICENSED MANUFACTURERS OF
American Bell Telephone Co.'s
Magneto & Electro Call Bells, etc.
Manufacturers of all kinds of **Telephone** Instruments, Bells, Plugs Switch-Boards, Annunciator Drops, Spring Jacks, Post's MAGNETO ENGINES for Switch Tables, and dealers in all kinds of Telephone supplies and Tools. Full assortment of **Telegraph** Instruments, in stock and for sale at lowest prices. Also, Galvanized Line Wire, all numbers; Insulated Wire, all numbers; Insulators and Brackets, all sizes; Batteries, all kinds and sizes; full line **ELECTRIC LIGHT** SUPPLIES, at lowest rates.
Agents and Managers of Exchanges are requested to correspond with us before purchasing.
☞ We call special attention to our new improved Post's Magneto Call Bells. Samples sent on application to agents and exchanges.

THE STEVENS PATENT TOP CONTACT KEY.
PATENTED APRIL 10, 1883.
PRICE $4 EACH, Postpaid.

This is beyond question the most practical and best Telegraph Key yet produced. The Arched Arm and Top Contact secure, a flexibility which obviates the Tiresome and often Paralyzing jar of all keys with contact under the lever. The Platinums never batter down, last for years are easily replaced, and will not Stick with the finest adjustment and highest speed. The Leverage is unique, and produces very firm writing with he greatest ease. It is the Handsomest, most Durable and easiest working Key made. Do not be deceived by cheap and worthless keys.
WE GUARANTEE SATISFACTION. Liberal Discounts to Agents and Operators.
STANDARD ELECTRICAL WORKS, CINCINNATI, O.